AL/EQ-TR-1996-0040

UNITED STATES AIR FORCE
ARMSTRONG LABORATORY

Demonstration of Radiofrequency Soil Decontamination: Volume I

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October 1996

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DRAFT SF 298

1. Report Date (dd-mm-yy) August 1996	2. Report Type Final	3. Dates covered (from... to) June 1992 to December 1994

Title & subtitle emonstration of Radio Frequency Soil Decontamination: Vol I, Technical Evaluation Report (Vol I of III)	5a. Contract or Grant # F33615-90-D-4011
	5b. Program Element # 78008F
6. Author(s) Clifton F. Blanchard, Chesley R. Lyon, and Laura H. Whitt	5c. Project # 3788
	5d. Task #
	5e. Work Unit # 3073

7. Performing Organization Name & Address Halliburton NUS Environmental Corporation 800 Oak Ridge Turnpike Oak Ridge, Tennessee 37830	8. Performing Organization Report #
9. Sponsoring/Monitoring Agency Name & Address Armstrong Laboratory Environics Directorate Site Remediation Division 139 Barnes Drive, Suite 2 Tyndall Air Force Base, FL 32403-5323	10. Monitor Acronym USAF
	11. Monitor Report # AL/EQ-TR-1996-0040

12. Distribution/Availability Statement Approved for public release. Distribution unlimited.

13. Supplementary Notes

14. Abstract The Air Force Armstrong Laboratory, Tyndall Air Force Base, Florida, has supported the research and development of Radio Frequency Soil Decontamination. Radio frequency soil decontamination is essentially a heat-assisted soil vapor extraction process. Site S-1 at Kelly Air Force Base, Texas, was selected for the demonstration of two patented techniques. The site is a former sump that collected spills and surface runoff from a waste petroleum, oils, and lubricants and solvent storage and transfer area. In 1993, a technique developed by the ITT Research Institute using an array of electrodes placed in the soil was demonstrated. In 1994, a technique developed by KAI Technologies, Inc. using a single applicator placed in a vertical borehole was demonstrated. Approximately 120 tons of soil were heated during each demonstration to a temperature of about 150 degrees Celsius.

15. Subject Terms Radio Frequency Soil Heating, Soil Vapor Extraction

Security Classification of			19. Limitation of Abstract	20. # of Pages	21. Responsible Person (Name and Telephone #)
16. Report classified	17. Abstract Unclassified	18. This Page Unclassified	Unlimited	137	Capt Jeffrey A. Stinson (904) 283-6254

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PREFACE

This report was prepared by Halliburton NUS Environmental Corporation, 800 Oak Ridge Turnpike, Oak Ridge, TN 37830 under contract F33615-90-D-4011 for the Armstrong Laboratory Environics Directorate (AL/EQW) (formerly the Air Force Engineering and Services Center), Tyndall AFB, FL 32403-5323.

This final report summarizes the project's Phase I efforts for a field demonstration of the IIT Research Institute's (IITRI) tri-plate capacitor and the KAI Technologies, Inc.'s (KAI) antenna radio frequency heating (RFH) techniques for the enhancement of soil vapor extraction (SVE) for the in situ decontamination of soils.

The work was performed between June 1992 and December 1994. The AL/EQW technical project officers were Mr. Paul F. Carpenter (during the initial stage of the project) and Capt Jeffrey A. Stinson (during the latter stage of the project).

EXECUTIVE SUMMARY

The United States Air Force developed the Installation Restoration Program to assess past hazardous waste disposal and spill sites and prepare remedial actions consistent with the National Contingency Plan for those sites that pose a threat to human health or the environment. Within that program the Site Remediation Division of the Environics Directorate of the Air Force's Armstrong Laboratory at Tyndall AFB, Florida, has supported the research and development of Radio Frequency Soil Decontamination.

Armstrong Laboratory was sufficiently encouraged by the early test results in sandy soils at Tyndall AFB, Florida, and Volk Field, Wisconsin, to pursue larger-scale demonstrations in tight soils that are more difficult to treat. In September 1991, the Air Force Center for Environmental Excellence at Brooks AFB, Texas, contracted Halliburton NUS Environmental Corporation (now Brown & Root Environmental) to conduct pilot scale demonstrations of two different, patented, radio frequency heating techniques at Site S-1 at Kelly AFB, Texas.

The project was divided into three phases the Preplanning Phase, Phase I, and Phase II. The Preplanning Phase, completed in September 1992, included literature review, conceptual cost estimations, design plans and specifications preparation and review, and publication of a final report documenting the results. Phase I included two integrated pilot tests and the preparation of this final technical report evaluating the results of Phase I and the conceptual planning of Phase II. Phase II will include the complete planning and design of a full-scale commercial demonstration of radio frequency soil decontamination.

Radio frequency soil decontamination is essentially a heat-assisted vapor extraction process. Radio frequency energy applied to the soil causes polar molecules, including water and many organic compounds, to vibrate. This vibrational energy is lost as heat. The resulting rise in soil temperature vaporizes both water and contaminants, which may then be removed by application of a vacuum. Extracted vapors may be treated by a variety of methods, depending on the site and the nature of the contaminants. Vapors extracted during the demonstrations at Site S-1 were burned in a flare.

Two types of radio frequency soil heating were demonstrated at Site S-1 from January to August 1993 and 1994. In 1993, a technique developed by the IIT Research Institute that uses a series of exciter and ground electrodes placed in the soil was demonstrated. This technique was tested previously at Air Force sites. In 1994, a technique developed by KAI Technologies, Inc. which uses

an antenna-like device that may be placed in a vertical or horizontal borehole was demonstrated. Halliburton NUS Environmental Corporation provided site preparation services, the vapor extraction system, and supervised and coordinated all other aspects of the demonstrations.

Armstrong Laboratory, Kelly AFB, and the US Department of Energy have contributed funds and guidance for the work completed to date which includes the Preplanning Phase and Phase I. In addition, the Phase I demonstrations are part of the US Environmental Protection Agency's Superfund Innovative Technology Evaluation Program.

Halliburton NUS Environmental Corporation concludes that data gathered during the pilot demonstrations is invaluable to the development of radio frequency heating for the enhancement of soil vapor extraction and can be used to design a commercial scale system and implement remedial activities in accordance with United States Air Force procedures. From lessons learned during the Site S-1 demonstrations, criteria for technology implementation have become apparent that allow the selection of a site better suited to the unique physical and chemical phenomenon inherent in the process. To date only six field tests have been completed. These tests have addressed situations with a wide variance of soil and contaminant characteristics. A phased approach is recommended which would include more demonstrations to plug data gaps and define unknowns followed by commercial scale application. A smaller site with a simpler (more homogenous) soil and contaminant matrix, relative to Site S-1, would simplify the evaluation of results and better define technology applicability.

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I. INTRODUCTION

The purpose of this document is to present the results of the in situ radio frequency heating soil decontamination experiment performed at Kelly Air Force Base, Site S-1, San Antonio, Texas. The heating portion of the experiment was performed from April 3, 1993 to June 3, 1993.

A number of different organizations were involved in this project. These were:

- HALLIBURTON NUS: USAF's prime contractor in charge of the demonstration project.

- IIT Research Institute: Subcontractor to HALLIBURTON NUS; technology developer and operator of the in situ heating system; analysis of soil for diesel range petroleum hydrocarbons.

- USEPA SITE Program Office: Technology evaluation and assessment including the analysis of soil samples for contaminant concentration.

- SAIC: USEPA's contractor for SITE program.

A. BACKGROUND

IIT Research Institute (IITRI) has been working with HQ AFCESA/RAVW, Tyndall Air Force Base for many years to develop the RF technology for in situ soil decontamination. The RF technology was originally conceived and developed for uniform heating of large volumes of earth formations for in situ fuel recovery. The technology was modified for soil decontamination purposes. IITRI had a number of contracts over the past years from U.S. Air Force, U.S. Environmental Protection Agency (EPA), and U.S. Department of Energy (DOE) to develop various aspects of the technology.

The radio frequency (RF) soil decontamination technology is based on in situ heating of soil through dissipation of electromagnetic energy in the RF band to volatilize the contaminants followed by collection and treatment of the effluent. The RF technology requires two major subsystems: the RF heating system and the effluent containment collection, and treatment (ECCT) system. The RF heating system includes the electrode array and the RF shield, RF power source, and matching network; the ECCT system includes the vapor barrier, vapor collection system, blower, and the vapor treatment system (VTS).

Energy is applied to the soil by energizing an array of electrodes placed in bore holes drilled through the contaminated soil. The electrodes are fabricated from copper and aluminum tubing or pipe. Selected electrodes are perforated and also connected to a vacuum system for the collection of the vaporized contaminants, water vapor and air. A vapor barrier and a RF shield is placed on top of the electrode array. The vapor barrier is needed to prevent emissions of the vaporized contaminants from the heated surface of the soil. The RF shield is needed to reduce RF emissions to low levels so that to avoid RF interference with other electronic systems and also to reduce RF emissions to safe levels.

B. SITE HISTORY

The demonstration experiment was conducted at Site S-1, located near the northern boundary of Kelly Air Force Base (AFB), Texas. This site was used as an intermediate storage area for wastes to be reclaimed off-base. The waste liquids were stored in storage tanks. Mixed solvents, carbon cleaning compounds, petroleum oils and lubricants (POL) were handled at the storage area. The soil is contaminated due to waste spills that occurred during waste transfer and storage tank overflow. The spilled material accumulated in a sump at the bottom of a nearby depression in the ground. The site was used from 1960 to 1973. It is reported that the depression was back filled with fill material after site operations were terminated. Figure 1 illustrates the general location of the site on Kelly AFB.

C. PROJECT BACKGROUND

Work was initiated by IITRI on this project on November 2, 1992. Prior to this, IITRI had completed a bench scale treatability study (Reference 2a) to determine the feasibility of the removal of diesel range TPH from Site S-1 soil. In the same project (Reference 2b), the design of a demonstration system based on 120 kW of input RF power was made. Subsequently, the design was revised in this project for an input power level of 40 kW in order to allow the demonstration to be done with IITRI's RF power source.

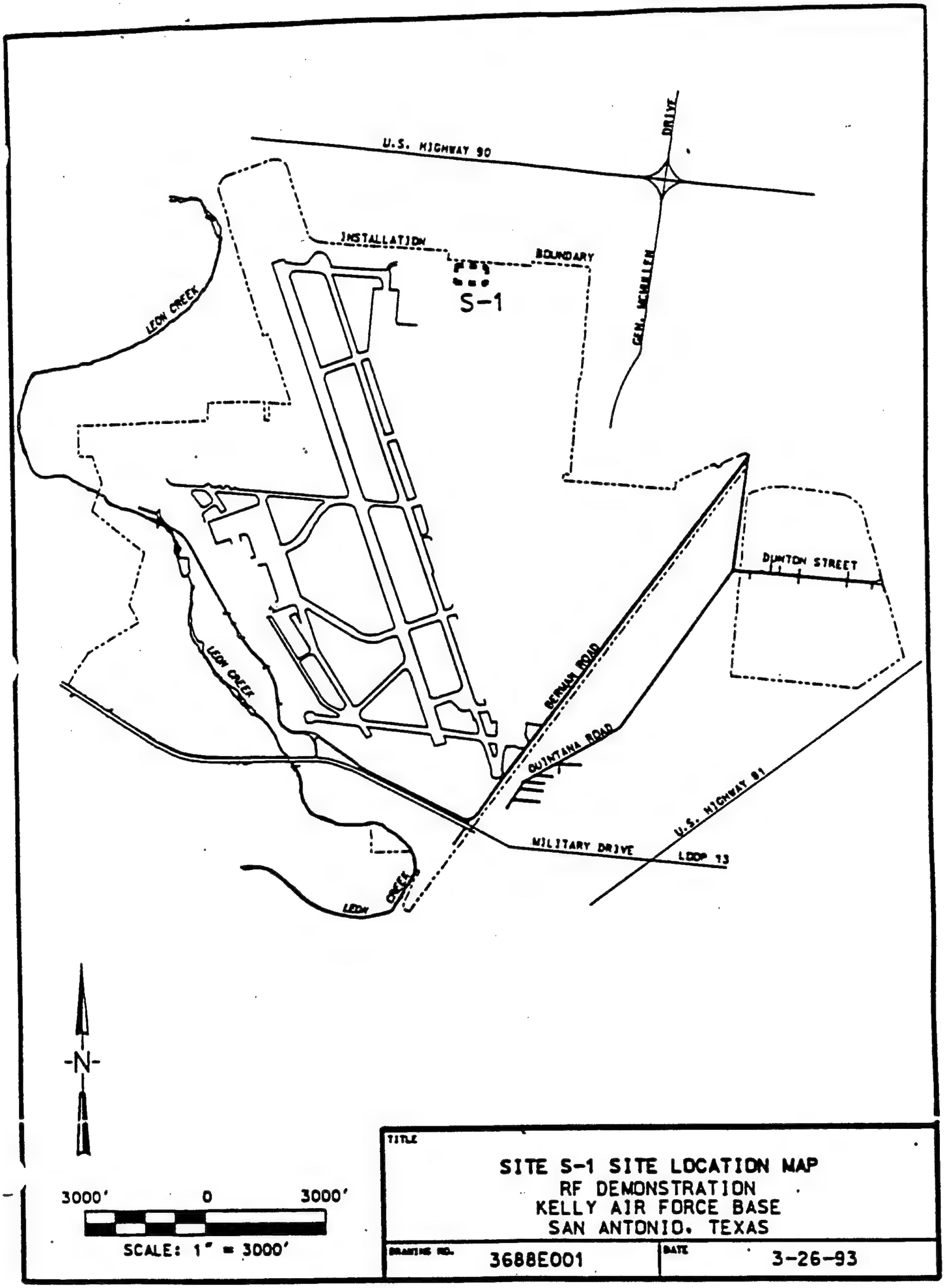

Figure 1. Locatior ap for Site S-1.

II. DEMONSTRATION OBJECTIVES

The main objectives of the field demonstration test were the following:

- Obtain a greater than 90 percent removal efficiency from the soil for the following four semi-volatile organic compounds: 2-methynaphthalene, naphthalene, 2,4,6-trichlorophenol, and 2-methylphenol

- Obtain greater than 95 percent removal efficiency from the soil for the following four volatile organic compounds: benzene, toluene, ethylbenzene, and chlorobenzene

- Obtain greater than 90 percent removal of the diesel range total petroleum hydrocarbons (TPH).

- Measure the removal of three ring PAHs, bis(2-ethylhexyl)phthlate and other semi-volatiles found at the site.

It was planned to heat the soil to an average temperature of 150° C. This treatment temperature was selected based on the results of a laboratory treatability study in which the removal of diesel range organics from samples of site S-1 soil was studied.

The RF in situ soil decontamination process was tested by heating a soil volume of dimensions: 17.5 ft long, 10 ft wide and 20 ft deep. In the original design the depth of the heated zone was 24 ft, but this was changed during system installation. The change was necessary because ground water table was shallower than expected.

This project was accomplished by performing the following 13 tasks:

Task 1:	Scale Down Design and Document	(C06770)
Task 2:	Revise Work Plan and Schedule	(C06773)
Task 3:	Review Health and Safety Plan	(C06774)
Task 4:	Review of Sampling and Analysis Plan	(C06775)
Task 5:	Assist in Obtaining Permits	(C06771)
Task 6:	Procurement and Equipment Fabrication	(C06772)
Task 7:	System Installation	(C06776)
Task 8:	Start up and Shakedown of System	(C06778)
Task 9:	Perform Demonstration and Cool Down	(C06779)
Task 10:	Decontamination and Demobilization	(C06786)

Task 11:	Review Data, Cost Analysis and Write Final Report	(C06781)
Task 12:	Attend Meetings	(C06782)
Task 13:	Analyze Pre-Demonstration Soil Samples	(C06784)

III. SITE DESCRIPTION[1]

A. REGIONAL SETTING

1. Geography

Kelly AFB lies in the western portion of the Gulf Coastal Plain, a gently undulating prairie with elevations ranging from 450 feet to approximately 700 feet above the National Geodetic Vertical Datum (NGVD). The plain slopes to the Southeast toward the Gulf of Mexico. Elevations at Kelly AFB vary from 730 to 620 feet above NGVD. Lower elevations lie along Leon Creek at the southern boundary of the base.

The San Antonio area lies within two distinct physiographic regions, the Edwards Plateau section of the Great Plains Province and the western Gulf Coastal Plain. The southwest-northeast trending Balcones Escarpment divides the two regions. The plateau serves as a recharge area for surface waters flowing to aquifers and streams extending through the San Antonio area.

2. Geology

The region surrounding Kelly AFB is underlain by Quaternary alluvium over a thick stratigraphic sequence of Cretaceous sediments. The alluvium consists of mixtures of clay, silt, and gravel. These deposits are typically 10 to 35 feet thick. The Cretaceous unit is the Navarro Group clay. The Navarro Group clay and other limestone and shale units form a thick sequence between the alluvium and the underlying Edwards Group limestone.

3. Hydrology

<u>Surface Drainage</u>

Surface runoff at Site S-1 drains eastward to Apache Creek, approximately 2.5 miles away. Apache Creek flows into San Pedro Creek, which in turn flows into the San Antonio River.

<u>Groundwater</u>

Kelly AFB lies above two groundwater aquifers. The uppermost aquifer lies within the lower strata of the Quaternary alluvium. Although this aquifer is capable of providing potable

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[1]Material in this Section is taken from Preplanning Report for the Demonstration of Radio Frequency Soil Decontamination -- Site S-1, HALLIBURTON NUS, USAF Contract No. F33615-90-D-4011, Delivery Order No. 0007, November 1993.

water, the quality and quantity are variable and questionable. The second aquifer is contained within the Edwards Group and is separated from the first aquifer by the Navarro Clay. The Texas Legislature established the Edwards Aquifer Underground Water District in 1959 to provide for the systematic planning and protection of groundwater in this aquifer. The EPA designated the Edwards a sole source aquifer in 1975 (40 CFR 149).

B. SITE S-1

1. Location

Site S-1 lies in the northern part of Kelly AFB, immediately south of Growdon Drive, north of West Thompson Drive, and west of a railroad spur near Building 1592.

2. Site History

Site S-1 served as an interim storage area for wastes to be reclaimed off base from the early 1960s to 1973. The western two-thirds of the site served as a temporary storage for electrical transformers and scrap metal. Liquid wastes, including mixed solvents and POLs were stored in above-ground tanks. Any spillage that occurred during storage, loading, and unloading flowed into a low area near the tanks. The site was later regraded after the abandonment and removal of the tanks.

Investigators observed a circular depression on old aerial photographs and investigated it as a possible dump site. No landfill material was found, and the depression area and a sump located within the depression were leveled with fill material. This waste oil sump is shown Figure 2 as a northwest - southeast trending region covering an area of approximately 40 by 150 feet. Further drilling has revealed a northwest-southeast-trending extension of the sump on the northeast side of the site.

3. Topography and Drainage

Site S-1 is generally flat, with surface elevations ranging from 690 to 691 feet above NGVD. Gravel covers the area over the former sump, but grass covers most of the remainder of the site. Rainfall at the site is likely to pool on the surface because of the slight topographic relief and low infiltration rates.

4. Geology

The alluvial material at Site S-1 consists of an upper layer of dark brown to black clay typically 7 feet thick overlying either a reddish brown silty clay or a clayey gravel, sand/gravel unit. The reddish brown silty clay lies in the southeast corner of the

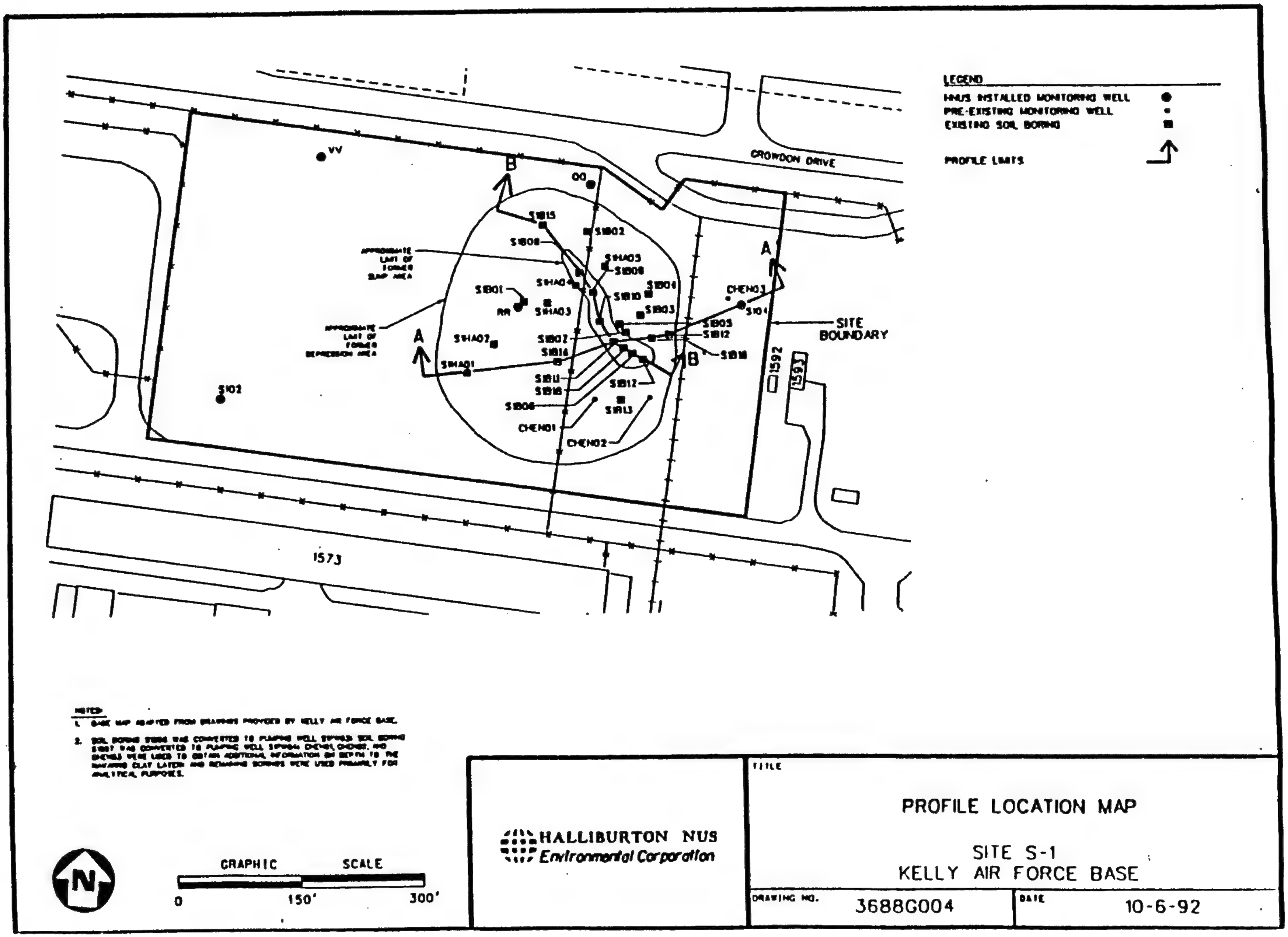


Figure 2. Site S-1.

site and is usually 7 to 10 feet thick. The coarse-grained unit underlying the remainder of the site consists of surrounded to subangular limestone and chert.

Results from two grain size analyses of the sand and gravel unit collected from a boring adjacent to Site S-1 (AP02) show that the alluvial aquifer is approximately 40% sand, 40% gravel, and 20% fine-grained material. These results as well as other geotechnical samples collected at Kelly AFB demonstrate a significant variability in the porosity and permeability of the alluvium.

Much of the alluvium was removed and replaced by fill material in the former depression area. The fill material is dark brown to black gravely clay with occasional zones of sand and silt covering an area approximately 150 by 300 feet. The depth ranges from 0 feet at the edge of the sump to 25 feet at its center. Large limestone and chert gravels up to 3 inches in diameter inhibited recovery during drilling throughout most of the unit.

The regional aquitard, the Navarro Group clay, lies 28 to 33 feet below the former depression area. Under Site S-1, the Navarro clay is a mottled, orange-brown to gray, stiff, plastic clay with crude laminae. A few borings have revealed silty horizons within the clay.

5. Hydrology

Water level measurements recorded between mid-1989 and late-1990 indicate that the direction of groundwater flow is towards the northeast. The water table beneath the site ranged from 25 to 30 feet below the surface, with a saturated aquifer thickness of 3 to 6 ft. The maximum water level fluctuation observed in the vicinity of Site S-1 was 3.25 ft. Northeast of the site,water level measurements made on April 30, 1992 indicated that groundwater gradient was 0.016 ft/ft, much higher than the 0.003 ft/ft gradient found immediately downgradient of the site. A local high are in the Navarro clay in combination with a groundwater mound effect appears to be the cause for the steep gradient across the sump.

6. Levels and Extent of Contamination

Soils

Site S-1 analytical results show significant contamination in the location of the former sump. The contamination consists of polychlorinated biphenyls (PCBs) in surface soils (9,000 μg/kg) and volatile organic compounds (VOCs) and semivolatile organics in the subsurface. The compound groups most prevalent in the subsurface are halogenated benzenes, methyl phenols, phthalates, and polynuclear aromatic hydrocarbons (PAHs).

Compounds with the highest concentrations in the soil are 1,2-dichlorobenzene (1,200,000 μg/kg) and 1,4-dichlorobenzene (720,000 μg/kg). Table 1 shows the maximum concentration of each VOC and semivolatile compound detected by fixed-base or field laboratory analysis.

Horizontally, the contamination at Site S-1 is largely confined to a 110 by 120-foot area surrounding the sump. Vertically, most of the organic contamination in the soil lies in a 10 to 15-foot thick horizon 17 to 33 feet below the surface in boring S1B10 and S1B11. Although surface staining is evident in aerial photographs, little contamination is found above a depth of 10 feet. Another zone of contamination, isolated from the lower unit, was detected in boring S1B08 at a depth of approximately 12 feet. The lower extent of the contamination in this isolated area could not be determined because of poor sample recovery.

Table 1. Organic Compounds Detected in Soils, Site S-1, Kelly AFB, Texas

Volatile Organics	Chemical Formula	Molecular Weight	Boiling Point at 1 atm., (°C)	Specific Gravity	Temperature at which Vapor Pressure is 1 mm Hg (°C)	Vapor Pressure at 20°C (mm Hg)	Maximum Concentration (µg/kg)
1,2-Dichlorobenzene	$C_6H_4Cl_2$	147.01	180	1.3048	20	1	5,100
1,4-Dichlorobenzene	$C_6H_4Cl_2$	147.01	174	1.2475	<50	0.6	5,100
1,3-Dichlorobenzene	$C_6H_4Cl_2$	147.01	173	1.2884	12.1	2 (25 deg)	1,800
Styrene	C_8H_8	104.2	145	0.9060	-7	5	1,100
Ethylbenzene	C_8H_{10}	106.2	136	0.8670	-9.8	7.1	2,700
Chlorobenzene	C_6H_5Cl	112.6	132	1.1058	-13	9	3,200
2-Hexanone	$C_6H_{12}O$	100.2	128	0.8113	7.7	2	32
Tetrachloroethene	C_2Cl_4	165.8	121	1.6227	-20.6	14	4
Toluene	C_7H_8	92.2	111	0.8669	-26.7	22	6,800
Trichloroethene	C_2HCl_3	131.4	87	1.4642	-43.8	57.8	12
Benzene	C_6H_6	78.1	80	0.8787	-36.7	76	1,200
2-Butanone	C_4H_8O	72.1	80	0.8054	-48.3	77.5	53
1,1,1-Trichloroethane	$C_2H_3Cl_3$	133.4	74	1.3390	-52	100	24
Vinyl Acetate	$C_4H_6O_2$	86.1	72	0.9317	-48	83	4
Chloroform	$CHCl_3$	119.4	62	1.4832	-58	160	17
Trans-1,2-Dichloroethene	$C_2H_2Cl_2$	96.9	48	1.2565	-65.4	265	200
Methylene Chloride	CH_2Cl_2	84.9	40	1.3266	-70	348.9	130

Table 1. Organic Compounds Detected in Soils, Site S-1, Kelly AFB, Texas (Continued)

Semi-Volatile Organics/PCBs	Chemical Formula	Molecular Weight	Boiling Point at 1 atm., (°C)	Specific Gravity	Temperature at which Vapor Pressure is 1 mm Hg (°C)	Vapor Pressure at 20°C (mm Hg)	Maximum Concentration (µg/kg)
Aroclor-1260	Varies	≈370	385 - 420	1.5660		6E-5 (25 deg)	6,700
Benzoperylene	$C_{22}H_{12}$	276.3	>500			1.0E-10 (25 deg)	230
Indeno-(1,2,3)-Pyrene	$C_{22}H_{12}$	276.3	536			1.0E-10 (25 deg)	190
Dibenzo Anthracene	$C_{22}H_{14}$	278.4	524	1.2820		1.00E-10	160
Benzo Pyrene	$C_{20}H_{12}$	252.3	495	1.3510		5.00E-07	390
Benzo Fluoranthene	$C_{20}H_{12}$	252.3	480			5.00E-07	700
Chrysene	$C_{18}H_{12}$	228.3	448	1.2740		6.30E-07	580
Benzo Anthracene	$C_{18}H_{12}$	282.3	439	1.2740		2.00E-09	520
Pyrene	$C_{16}H_{10}$	202.3	393	1.2710		2.5E-6 (25 deg)	940
Fluoranthene	$C_{16}H_{10}$	202.3	375	1.2520		5.00E-06	9,000
Anthracene	$C_{14}H_{10}$	178.2	340	1.2830	145	2.00E-04	130
Pentanthrene	$C_{14}O_{10}$	178.2	340	0.9800	118.2	2.10E-04	920
Acena Phthylene	$C_{12}H_{12}$	152.2	265	0.8988		2.90E-02	20
2,4,6-Trichlorophenol	$C_6H_3Cl_3O$	197.5	246	1.4900	76.5	1.7E-2 (25 deg)	100,000
2-Methlynaohthalene	$C_{11}H_{10}$	142	241	1.0058			12,000
Di-n-Octyl Phthalate	$C_{24}H_{38}O_4$	390.6	220	0.9900		1.4E-4 (25 deg)	2,800
Naphthalene	$C_{10}H_8$	128.2	218	1.0253	52.6	5.40E-02	10,000
Bis(2-Ethylhexyl)-Phthalate	$C_{24}H_{38}O_4$	390.6	218	0.9843		2.00E-07	57,000
2,4-Dimethylphenol	$C_8H_{10}O$	122.2	212	0.9650	51.8	6.20E-02	2,400
2,6-Dimethylphenol	$C_8H_{10}O$	122.2	203	0.8600	58		2,200
2-Methyphenol	C_7H_8O	108.1	191	1.0273	38.2	0.3 (25 deg)	8,100
Phenol	C_6H_6O	94.11	182	1.0722	40.1	0.2	3,200

IV TECHNOLOGY DESCRIPTION

A. PROCESS DESCRIPTION

In situ radio frequency (RF) heating and soil decontamination is a two-step process. These steps are: heating of soil to the treatment temperature, and recovery and treatment of the volatilized contaminants. Once the soil temperature is elevated above 40° to 50° C, these two steps work simultaneously.

In situ heating is accomplished by energizing an array of electrodes emplaced in bore holes drilled through the soil. The electrode array is supplied with electromagnetic (EM) energy in the RF band, typically between 2 and 13 MHz. The actual operating frequency is selected from the available ISM band frequencies in the above range. Typically three rows of electrodes are utilized. The two outer rows are called the guard electrodes and they serve to confine the energy to a well defined volume of the soil. The center row is called the excitor row. Figure 3 is an illustration of the in situ RF heating process depicting the electrode rows and the vapor collection system.

In RF heating, mechanism of heat generation is similar to that of the microwave oven. Electrical energy is dissipated volumetrically and converted to thermal energy due the absorption of EM energy by moisture and soil. The primary mechanism of energy absorption is the rotational and vibrational displacement and physical distortion of dipoles induced in polar molecules. The dielectric properties of soil determine the amount of RF power that can be dissipated in the soil. These properties are the relative dielectric constant (ϵ_r) and the loss tangent. The loss tangent, $\tan(\delta)$ is defined as $\sigma/(\omega\epsilon_o\epsilon_r)$ where σ is the apparent conductivity, ω is the frequency of the applied electric field, radians/sec, and ϵ_o is the permittivity of free space, and it equals 8.85×10^{-12} farads/meter. All the dielectric properties are a function of soil temperature, the frequency of the applied field and the composition of the major components. The amount of RF power dissipated in the soil is directly related to the frequency of the applied electric field, square of the amplitude, the relative dielectric constant and the loss tangent.

Due to its volumetric nature, the process does not depend upon conductive transport of thermal energy, even though thermal conduction does occur. With an appropriate array design and operating strategy, it is theoretically possible to obtain uniform heating of the soil volume enclosed within the two outer rows of the excitor array.

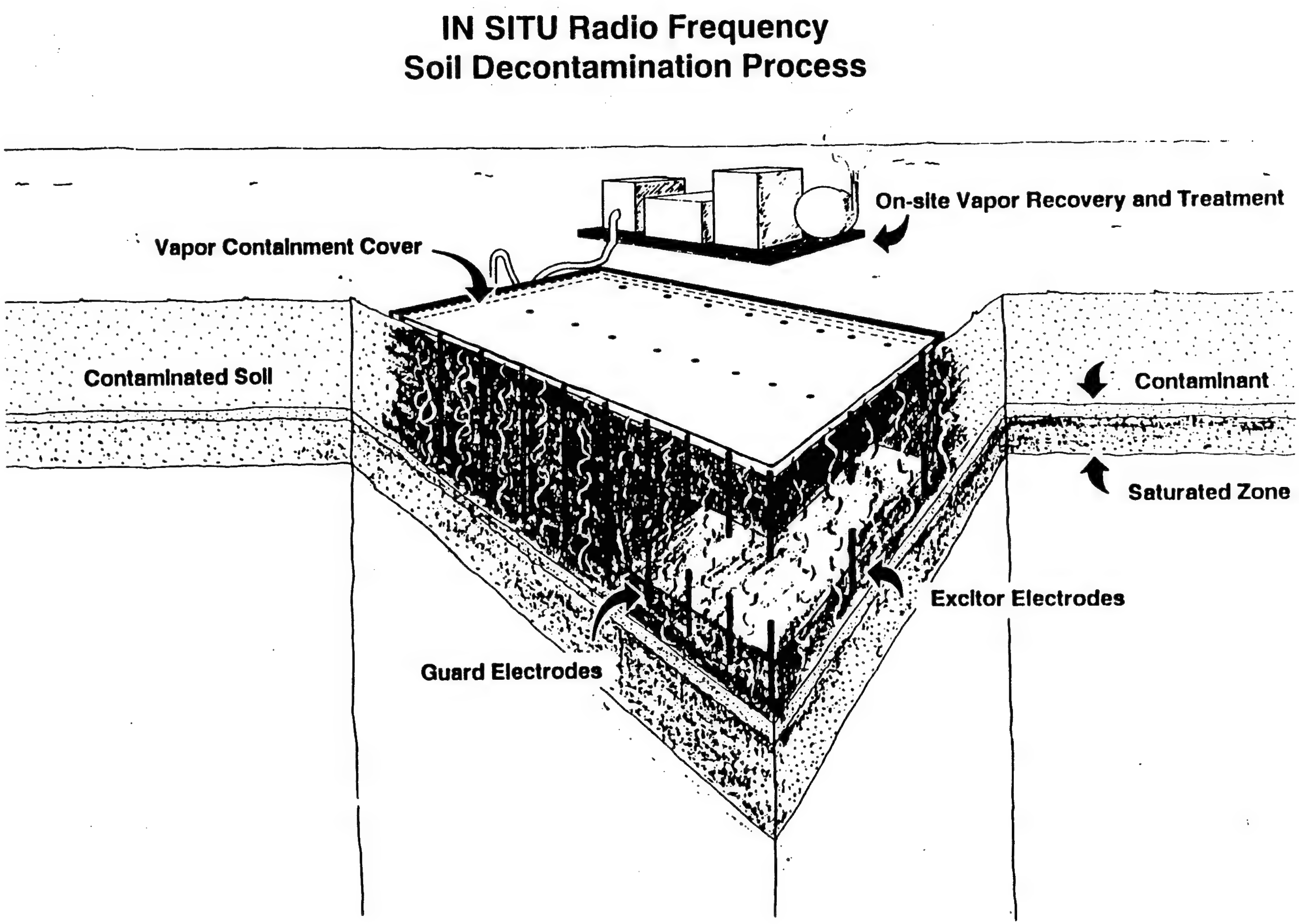


Figure 3. Artist's Illustration of the RF Process.

As the soil heats up, the soil moisture and the organic contaminants begin to vaporize and they will eventually boil depending upon the final temperature and their boiling points. The vaporized and boiled materials are removed from the soil matrix by applying a vacuum to gas collection points. These points are vented electrodes placed in the array used to heat the soil. The preferred location of the gas collection electrodes is in the middle of the electrode array. This is the best location because the temperature rises first and reaches a higher level in the central row of electrodes. Collection of hot vapors from the central electrode row at high operating temperatures is however, technically challenging, because collection piping must be non-metallic and poses suitable dielectric insulating properties so as to prevent arcing and radiation of RF energy.

Vapors may also be collected from the surface of the heated zone as well as from the two outer rows of the electrode array. Collection from the two outer rows poses less electrical design challenges because metallic piping may be used here. Gases and vapors produced in the soil volume will also rise directly to the surface due to diffusion, and buoyancy. These may be collected at the surface by means of horizontal perforated gas collection lines placed on the surface of the soil. Depending upon their positioning these lines may be made from metal.

A vapor containment barrier is needed to prevent emissions from the heated soil surface. Typically this barrier must possess high temperature operating characteristics, be impermeable to organic vapors, and must be a suitable dielectric insulator. An elastomeric material like silicon rubber sheets can be used.

Figure 4 is a conceptual block diagram depicting the RF process. Electrical energy from the utility grid is converted to the high frequency electromagnetic energy by a RF power source. This source can be a modified radio transmitter, an amplifier or an oscillator. RF power sources can be trailer mounted for easy transportation to the waste sites. The output of the RF power source is conveyed to a matching network which optimizes the transfer of power between the source and the load. The load comprises of the electrode array along with the soil.

The recovered gas stream may need treatment prior to discharge to the environment. The type of treatment and clean-up required depends on the nature, concentration and total amount of contaminants present in the gas stream. Any proven technology for the clean up of the vent gas stream may be used, provided it can be built in transportable trailer mounted modules. Several options for gas treatment are available:

- Open release of dilute streams of hydrocarbons

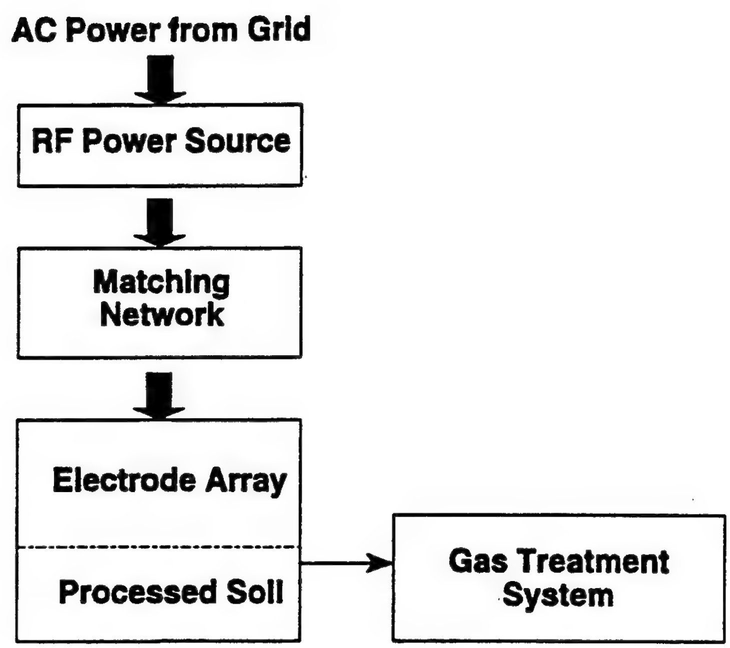


Figure 4. Conceptual Block Diagram of the RF Process

- Cooling, condensation, carbon treatment
- Incineration
- Catalytic incineration
- Appropriate combination of above

During the in situ heating of soil several different phenomena occur which help in the vaporization and recovery of the contaminants. First, there is the development of effective permeability to gas flow in the soil matrix. Second there is the increased sweep of air and steam through the treatment zone and third, there is the possibility of steam distillation reducing the boiling point of a multi-phase mixture of organic and aqueous phases.

The effective permeability to air flow increases as the soil water is removed by evaporation and boiling, the vacated pore space becomes available for the flow of steam, vapors and air.

As the permeability to gas flow increases, a sweep of air or steam can be easily established in the soil to help facilitate the removal of organic vapors which are in the soil pore space. The air flow is induced in the soil by the application of vacuum. The steam flow is created by the applied vacuum and boiling of native soil moisture present in the heated volume and of any new water entering the heated zone from the surrounding soil. For some combinations of soil types and contaminants the effect of steam flow may be more beneficial in the removal of the contaminants from the soil matrix than an equivalent flow rate of air.

Figure 5 is a graph depicting the increased permeability to the flow of nitrogen gas in a small sample of clayey soil packed inside a cylindrical device for measuring permeability. The figure illustrates that as the pore saturation of water is reduced, the permeability to air flow increases. It does not matter how the water is removed from the soil pores. Data for two operating modes is presented. In the first, the soil moisture is removed at elevated temperature by heating the core. In the second operating mode, the soil moisture was removed by a nitrogen sweep through the core which was maintained at room temperature. The first operating mode is of course faster in obtaining the permeability change.

Steam distillation of organic liquids such as benzene, xylene, etc. occurs when a mixture of the organic liquid and water is brought to a boil under condition where two or more liquid phases co-exits. Under these conditions, the mixture boils at a lower temperature than that of either of the two phases when present alone. The mixture boils when the partial pressure of all the vapor phase components above the mixture equals 760mm Hg or the prevailing atmospheric pressure. In a multi-liquid-phase mixture, each liquid phase exerts its own vapor pressure, which contributes

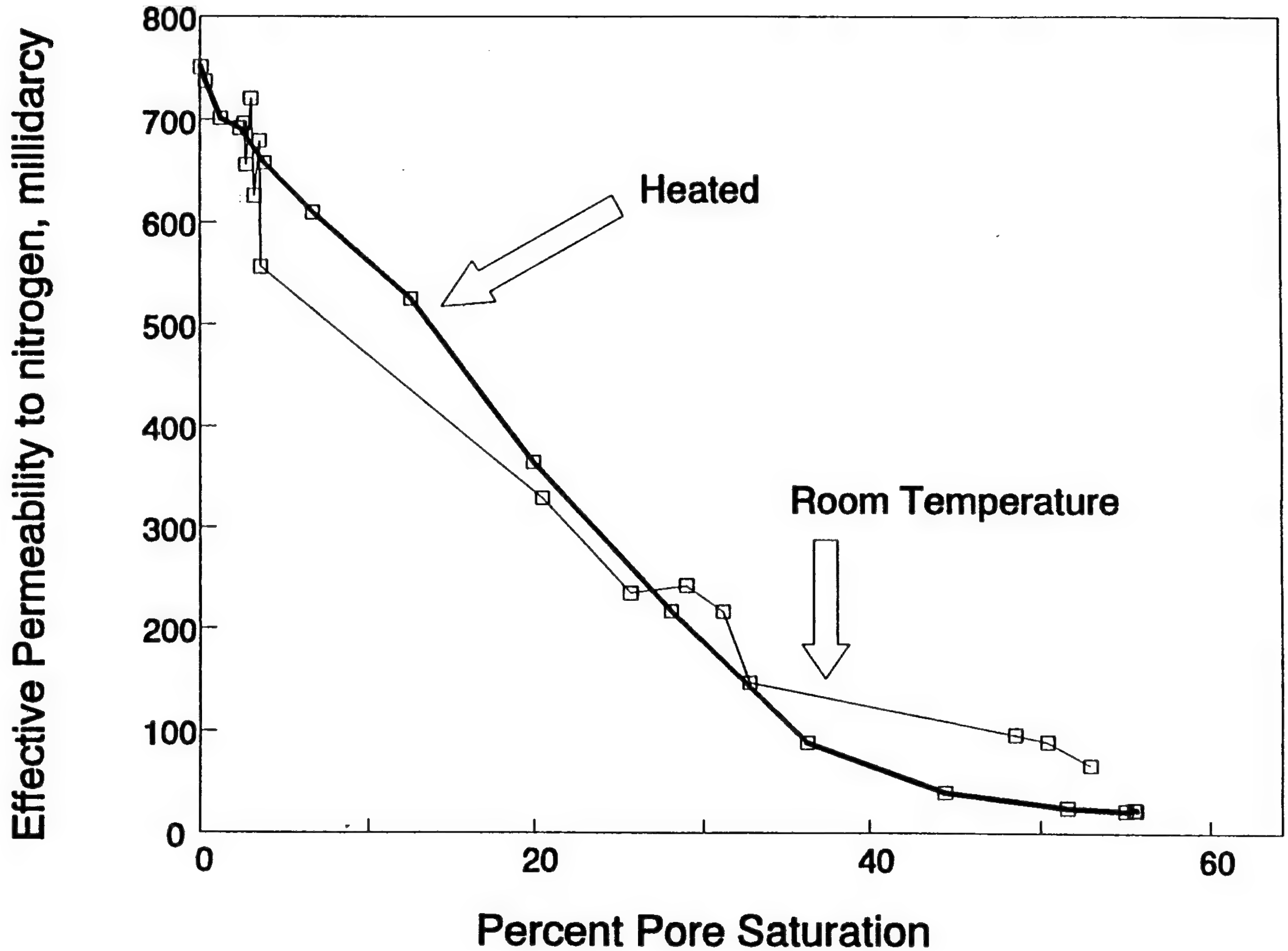


Figure 5. Soil Permeability as a Function of Pore Saturation

TABLE 2. BOILING POINT REDUCTION
(Steam Distillation Conditions)

Contaminant	Normal B.P., °C	Mixture B.P., °C	Steam/ Contaminant lb/lb
1,1,1 Tricholoroethane	74.1	64.4	0.04
Benzene	80.1	68.3	0.09
Toluene	110.6	83.9	0.24
Tetrachloroethylene	120.8	87.7	0.19
Bromoform	150.0	94.3	0.31
Hexachloroethane	186.0	98.7	1.57
Pentadecane	270.5	99.95	30.10

each liquid phase exerts its own vapor pressure, which contributes to the total pressure above the liquid surface. Due to this reason the mixture boils at a temperature less than that of either of the liquid phases present. Table 2 lists the pure component and the mixture boiling points when several common environmental contaminants are subjected to steam distillation conditions.

B. ENERGY REQUIREMENTS

The theoretical amount of thermal energy required to heat soil depends upon the following factors:

- Initial soil temperature
- Final treatment temperature
- Initial Soil moisture content
- Initial hydrocarbon content
- Thermal properties of moist and dry soil

The actual amount of thermal energy needed for the heating of soil depends upon the factors listed above and heat loss. Heat loss from the heated volume can occur in the following ways:

- conduction from the heated soil surface
- conduction from the sides and bottom of the heated block of soil
- heating of any air flowing through the hot zone
- convection and radiation from the heated surface

system and gets converted to steam represents an additional heat load, the economic penalty may be off set by the beneficial aspects of steam sweep on the removal of the contaminants from the soil. In any event, the rate of water intrusion has to be limited to reasonable level such that the power source can provide the necessary extra energy, otherwise the entire volume will not reach the desired temperature or else experience a temperature drop.

In a prior study (Reference 1) the heat loss from the first three mechanism listed above was estimated for heating of large blocks of soil to a depth of 20 ft. In this study approximately 1 acre of soil was heated at the same time using a large RF power source with heating time ranging from 0.25 to 0.5 year. Under such conditions it was estimated that the actual energy required can be 25 percent higher due to heat loss, than the theoretical amount needed.

The additional energy required due to water intrusion was not considered because it is a site specific variable and water intrusion may be controlled by other means. On the other hand it is almost impractical to reduce heat losses due to conduction while operating under in situ conditions.

Table 3 gives an estimate of the theoretical amount of thermal energy needed for heating up one ton of soil to a temperature of 150° C. The following assumptions were made: the soil contains 10 to 20 percent initial moisture, initial contaminant concentration of 1%, average contaminant latent heat of vaporization of 200 Btu/lb; and no water intrusion. Table 3 shows that when the soil contains 10 percent water, 60 percent of the theoretical energy is required to boil the water. When the soil contains 20 percent initial water, 75 percent of the theoretical energy is required to boil the water. The energy needed to heat the soil after accounting for the conductive heat losses may be estimated from Table 3 by adding 25 percent to the amounts shown. Thus the thermal energy needed is in the range of 120 to 190 kWh/ton of soil heated. The amount of RF energy required to heat the soil is also equal to the above estimate due to extremely low losses for RF transmission and 100 percent conversion from RF to thermal energy.

The amount of AC power needed from the utility to heat the soil is a function of the RF power requirements and the AC to RF conversion efficiency of the RF power source. The conversion efficiency ranges from 45 to 65 percent depending upon the type and design of the RF power source. Older, tube-based RF transmitters like IITRI's 40 kW unit, have a conversion efficiency of about 45 percent. Modern tube units have an efficiency ranging from 60 to

TABLE 3. THEORETICAL ENERGY REQUIRED TO HEAT SOIL TO 150° C

	Soil Moisture, %			
	10%		20%	
	Btu/ton	kWh/ton	Btu/ton	kWh/ton
Sensible heat required to reach 100° C	88,200	25.84	88,200	25.84
Heat Required to boil water	194,000	56.84	388,000	113.68
Heat required to boil contaminants	4,000	1.17	4,000	1.17
Heat required to raise temperature from 100° to 150° C	40,050	11.73	35,550	10.42
Total Heat Required	326,250	95.58	515,750	151.11

design of the RF power source. Older, tube-based RF transmitters like IITRI's 40 kW unit, have a conversion efficiency of about 45 percent. Modern tube units have an efficiency ranging from 60 to 65 percent. Future solid state units are projected to have conversion efficiency in the range of 70 to 75 percent.

The above discussion does not allow for the AC power requirements of the vapor treatment system. These requirements are estimated to be low, of the order of 10 percent of that needed for heating soil.

V. SYSTEM DESIGN AND INSTALLATION

The system as designed and implemented in the field at Site S-1 is described in this section. The purpose of this design was to heat soil to an average temperature of 150°C in order to meet the objectives listed in Section 2. The temperature of 150°C was selected based on the removal of diesel range organics observed during the soil treatability study done by IITRI in a prior project (Reference 2). The results of the treatability study are also summarized below.

A. TREATABILITY OF S-1 SOIL FOR THE REMOVAL OF DIESEL RANGE ORGANICS

1. SOIL SAMPLE DESCRIPTION

Three new bore holes were made by HALLIBURTON NUS on October 19, 1991, at the southeastern corner of site S-1. Two of these bore holes were on the center line of the pit while one was outside. Continuous coring was done during the drilling of these bore holes by means of a hollow stem auger drill. Table 4 summarizes the core recoveries, field OVA readings, HALLIBURTON NUS' analysis for TPH from selected core intervals, etc. Soil needed for the treatability study was selected from the samples sent to IITRI. In Table 4 the core sample used for each of the five experiments is also indicated by means of the experiment number.

Table 5 provides a list of other contaminants found in the new borings. As the data in Tables 4 and 5 show, TPH with a concentration of up to 980 ppm is by far the most abundant contaminant present in the soil samples analyzed for this study. Other contaminants listed in Table 5 are present at levels which are approximately one thousandth the concentration of TPH. The results from the samples obtained from SB-16 show that the concentrations are considerably lower 5 to 6 ft outside the original estimated location of the sump boundary. Thus SB-16 may indeed be outside the original boundary and also outside the zone of current contamination. The field demonstration should be performed in the southern edge of the sump, near the location of borings SB-17 and SB-18.

2. Treatability Study Objectives and Approach

Soil treatability experiments were performed to determine the required treatment conditions for the removal of petroleum hydrocarbons found in soils obtained from borings made in Site S-1, Kelly AFB. The main focus of the study was to determine the

TABLE 4. FIELD SCREENING AND LAB. ANALYSIS OF CORE SAMPLES OBTAINED ON 10/19/91, SITE S-1, KELLY AFB (All results in ppm)

Depth Interval	SB-17				SB-18				SB-16			
	TPH ppm	Moist %	OVA ppm	Recovery ft	TPH ppm	Moist %	OVA ppm	Recovery ft	TPH ppm	Moist %	OVA ppm	Recovery ft
2-7	400	20.3	40-700	4.5	<20	19.5	300-700	4 Exp5	<20	12.2	30-80	1.9
7-12	NA	NA	20	1	<20	24.7	100-1000+	4.6 Exp4	<20	9.2	5-80	4.5
12-17	NA	NA	10-40	1.0	<20	26.7	300-1000+	5 Exp2	NA	NA	0	0.8
17-22	980	8.5	200-300	2.0 Exp1	NA	NA	200-300	1.5 Exp3	NA	NA	15	0.4
22-27	NA	NA	40	0.8	110	15.7	500-700	2.5	-	-	-	0.0
27-32	-	-	-	0.0	NA	NA	700	2	NA	NA	0-2	0.8
32-37	-	-	-	0.0	<20	22.1	10-100	3	-	-	-	0.0

TPH: Total petroleum hydrocarbons as analyzed by HALLIBURTON NUS.
OVA: Field measurement for hydrocarbons
NA: Not Analyzed
-: No Sample Recovery

TABLE 5. CONCENTRATION (μg/kg) OF SEMI-VOLATILES IN BORINGS SB-16 TO SB-18

Chemical Name	SB-16	SB-17	SB-18		
	2-7'	2-7'	2-7'	22-27'	32-37'
1,2,4-trichlorobenzene				190	
1,2-dichlorobenzene				3600	230
1,3-dichlorobenzene		200		1600	
1,4-dichlorobenzene		1100		9300	
2-methylnaphthalene		2300		4400	
Benzo(a)anthracene	170				
Benzo(b)fluoranthene	260				
bis(2-ethylhexyl)phthalate		13000	640	1800	
Di-n-butylphthalate		200	250		
Fluoranthene	430	300			
Naphthalene		140			
Phenanthrene		200			
Pyrene	350				
Solids, wt %	87.8	79.7	80.5	84.3	77.7

Blank cells indicate the contaminant was below its quantitation limit
In SB-16, 7-12 ft all were below quantitation limit
In SB-17, 17-22 ft all were below quantitation limit
In SB-18, 7-12, and 12-17 all were below quantitation limit

temperature and time conditions necessary to remove at least 90 percent of the total petroleum hydrocarbons (TPH) as analyzed by the California DHS method (Reference 3) for TPH.

The analytical method allows for determination of TPH as gasoline or as diesel. In this study the TPH was reported as diesel to determine the condition necessary for the removal of higher boiling components represented by diesel. Most of the hydrocarbons in diesel contain nine to 21 carbon atoms. They are primarily straight and branched chain alkanes, alkyl benzenes and PAH. The boiling point range of the straight chain alkanes is in the range of 150°-376°C; the lowest boiling branched chain alkane in diesel boils at 306°C; the alkyl benzenes boil in the range of 80° to 255°C, and the PAHs boil in the range of 218°C to greater than 500°C. Thus most of the diesel components can be classified as semi-volatiles. Based on previous treatability studies performed by IITRI on clayey soils it is anticipated that lower boiling volatile organics would have even better removal efficiency under the same conditions that give greater than 90 percent removal for diesel range TPH.

The laboratory approach to the treatability study attempts to simulate the temperature and gas flow conditions that occur in situ. This approach was developed at IITRI over the last five years and was used to develop conditions for the successful field experiment at Volk ANGB (Reference 4). The treatability experiments were performed by packing the clayey soils of Site S-1 into a 1.5-in. diameter pipe. The soil column was heated with externally wrapped heating tapes. Gas flow was simulated by injecting at a controlled rate either nitrogen or superheated steam at the base of the soil column.

Under in situ conditions, as soil is heated and the native moisture is removed from the soil pores, the effective permeability to gas flow increases. Thus a gas and steam sweeping action is established in the heated zone due to the vacuum imposed for the collection of the contaminant gases, vapors and steam. The gas and steam sweep thus established helps to increase the rate of contaminant removal from the soil matrix. In the laboratory this sweeping action is simulated by injection of nitrogen, air or steam at the base of the soil column.

3. Experimental Apparatus

The treatability experiments were performed by heating a column of soil packed into a 1.5-in. diameter stainless steel pipe. The soil inside the pipe was heated by means of heating tapes wound around the pipe. Thermocouples were used to measure the temperature of the soil inside the pipe. The experimental set up is illustrated in Figure 6. The hot gases and vapors formed upon

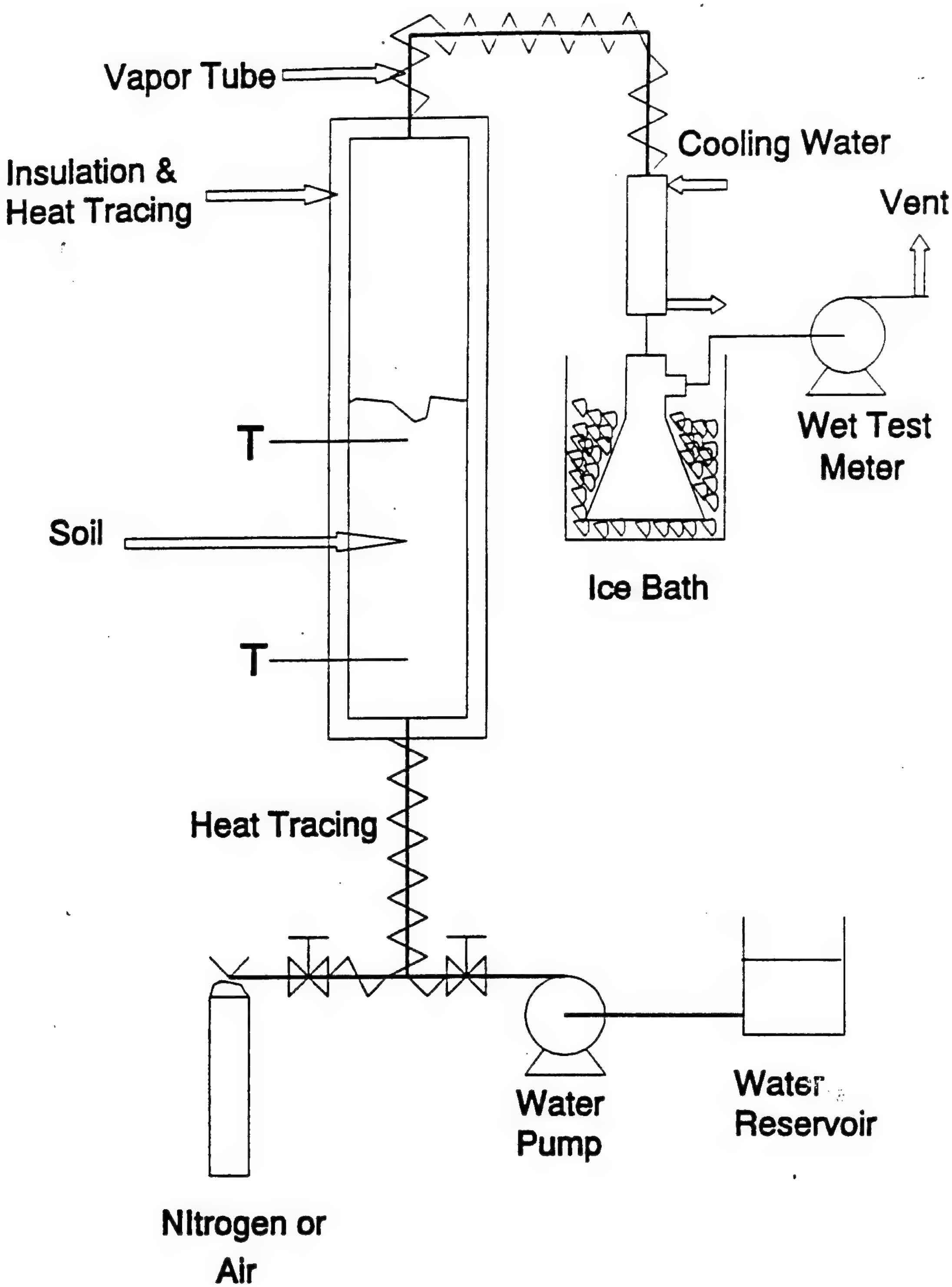


Figure 6. Soil Treatability Experimental Set Up

heating the soil pass through a heated vapor tube into a water cooled condenser. The outlet of the condenser is connected to a chilled condensate receiver wherein all the liquids formed in the condenser are collected. The uncondensed gases leaving the condensate receiver were passed through a wet test meter.

The soil column was equipped with an injection port at the bottom through which a selected gas (air or nitrogen) or superheated steam was introduced into the soil column to simulate the gas sweep established in the soil upon in situ heating and collection of the produced gases and vapors. The volume of uncondensed gas leaving the chilled condensate receiver was measured by means of a wet test meter as shown in Figure 2. When nitrogen or air was injected at the base of the column it was assumed that the uncondensed gas leaving the receiver was 100% v/v air or nitrogen. Superheated steam was made by pumping deionized water at a controlled rate through a heat traced tubing. The amount of water pumped through the soil column was determined by weighing the water reservoir.

4. Experimental Procedure

The cleaned stainless steel reactor was packed with soil core samples sent to IITRI by HALLIBURTON NUS. Only core samples obtained from the two bore holes made inside the pit were used in the treatability study. In all experiments soil obtained from a single core interval (5 ft length of core) was packed into the reactor. As the reactor was being packed, soil samples were taken for TPH analysis and transferred to a clean glass jar. In some cases, the collected soil sample was split into two portions, one of which was spiked with a solution of known concentration of diesel in carbon disulfide. The jar was sealed with a teflon lined cap and refrigerated pending analysis.

After packing the reactor with soil, the column was connected to the vapor condenser, the wet test meter and the gas injection system as shown in Figure 6. The experiment was begun by heating the column of soil while passing nitrogen or air through the column. During this phase of the experiment native water present in the soil was recovered along with the condensed contaminant vapors in the chilled receiver. Once the recovery of the native soil moisture had ceased (determined by visual observation in the glass condenser) then the nitrogen or air flow was stopped, and the condensate receiver was replaced with a new one. Steam injection was now begun. The temperature of steam entering the base of the soil column was measured and adjusted to match the average temperature of the soil in the column.

Once the final soil temperature was attained, the soil was maintained at the temperature for a period of 100 to 380 hours (the

soak period). During the soaking period the flow of sweep gas was maintained at a constant rate.

At the end of the soaking period steam injection was terminated and nitrogen was re-injected at the base of the column. The purpose of nitrogen injection was to remove all residual steam from the column. The experiment was then terminated and the soil was allowed to cool down to room temperature. During this period the reactor was kept vented to the condenser and the condensate recovery system.

Once the soil had cooled to room temperature, the reactor was opened and the soil was transferred to a clean 1-gallon glass jar. The jar was sealed and tumbled on a roller table for a period of 20 min. A sample of the treated soil was obtained from the gallon jar and transferred to a sample jar. In some experiments two samples were obtained, one of which was spiked with a solution of known concentration of diesel in carbon disulfide.

5. Experimental Results and Conclusions

Five soil treatability experiments were performed. The experimental conditions and TPH concentration in soil are shown in Table 6. The TPH removal calculation is summarized in Table 7. Detailed information regarding each experiment along with temperature profiles are provided in Reference 2. The data shown in Tables 6 and 7 are based on TPH analysis performed by IITRI.

The data in Table 6 indicate that in 2 of the 5 experiments the soil did not have significant amount of TPH contamination as compared to the other samples from the site. Results from the other three experiments show that TPH can be reduced to the range of 60 to 230 ppm depending upon the treatment condition. Thus increasing treatment temperature from 113° to 150°C has a significant effect on the final concentration of the soil. Due to the long residence time in the field, the actual removal of the TPH under field conditions is expected to be even higher than that seen in the laboratory.

The results of Experiments 1 to 3 indicate that with the specific combination of contaminants and the soil matrix there is no effect of the type of sweep gas (steam/nitrogen versus nitrogen alone) on the residual concentration of the TPH. In Experiment 2 a low percent removal was attained due to the low initial concentration of the TPH in the soil. Table 7 is a summary of the removal calculations which take into account the change in soil moisture upon heating.

The calculations summarized in Table 7 are based on a mass balance for TPH and moisture. The basis for performing the mass

TABLE 6. SOIL TREATABILITY EXPERIMENTAL CONDITIONS AND RESULTS

Expt. No.	Soak Temperature C	Soak Time hr	Nitrogen/ Air Sweep	Water Injection g/min	TPH Concentration ppm	
					Initial	Final
1	113	122	Nitrogen	4.6	3124	227.7
2	150	118	Nitrogen	5.2	198	70
					198	59.1
3	151	102	Nitrogen	0.0	2740	94
4	153	112	Air	0.0	59.9	11.5
5	112	388	Nitrogen	0.5	18.2	13

Expt 1: soil from boring SB-17, 17-22 ft depth
Expt 2: soil from boring SB-18, 12-17 ft depth. Three different treated samples were analyzed. First line provides the results of the first sample and the second line gives the average of the other two.
Expt 3: soil from boring SB-18, 17-22 ft depth
Expt 4: soil from boring SB-18, 7-12 ft depth
Expt 5: soil from boring SB-18, 2-7 ft depth

TABLE 7. CALCULATION OF TPH REMOVAL DURING TREATABILITY STUDY
(Basis: 100 gm of Initial Soil)

Expt. No.	IN INITIAL SOIL			IN FINAL SOIL		TPH REMOVED	PERCENT REMOVAL
	TPH Conc. µg/gm	Moisture %		TPH Conc. µg/gm	Moisture %	µg	%
1	3124.0	9.1%		227.7	0.1%	291747.8	93.4
2	198.0	26.8%		70.0	0.0%	14677.0	74.1
2	198.0	26.8%		59.1	0.0%	15474.8	78.2
3	2740.0	15.1%		94.0	0.0%	266044.4	97.1
4	59.9	23.4%		11.5	0.0%	5109.2	85.3
5	18.2	16.6%		13.0	2.8%	704.3	38.7

Expt 1. Initial Soil average of two analysis: 3371, and 2877 µg/gm

Expt 2. Three different treated soil samples were analyzed. First line provides the results of the first sample. The second line gives the average results of the other two samples.

Expt 3. Initial Soil analyzed two ways: by dilution for low level calibration: 2270 µg/gm
and by hi level calibration curve and no dilution: 2740 µg/gm.
Use hi level result.

balance was 100 gm of initial soil. Consider, as an example, 100 gm of initial soil used in Experiment 1. The soil contains 312,400 μg of TPH, 9.1 gm of moisture, and 90.59 gm of solids. The 90.59 gm of solids (considered as inert) remain unchanged upon heating, but the moisture content reduces to 0.1% and the TPH concentration reduces to 227.7 μg/gm. Thus, in the final soil, solids represent 99.88% of the total residual mass. The residual mass of final soil is 90.70 gm. Thus the amount of TPH present in 90.7 gm of final soil is 20,652 μg. The amount of TPH removed from the initial soil is (312,400 - 20,652) = 291,748 μg. Therefore, the removal of TPH, expressed as a percentage of initial TPH present in 100 gm of soil is (291,748/312,400) * 100 = 93.4 percent.

B. HEATING SYSTEM DESIGN

1. Design Heated Volume

The volume of the soil heated by the RF process is determined by the dimensions and geometry of the electrode array because the soil between the two outer electrode rows is heated. For this demonstration the size of the heated volume was limited by the size of the available RF power source, which was 40 kW. The soil was heated by installing an array of electrodes in the soil. The electrodes were installed in vertical bore holes drilled in three parallel rows. Figure 7 is a plan view of the electrode array implemented for the demonstration at Site S-1. The length of the two outer rows of electrodes (Rows A and C) is 17.5 ft and length of the Excitor row (Row B) is 7.5 ft. The depth of the two outer rows was 29 ft while the depth of the Excitor row was 20 ft. The heated volume will be determined by the geometry of the electrode array. As discussed above, the two outer rows are both longer and deeper than the central row. This was done to contain the fringing RF fields that emanate from the ends of the excitor row. Thus the volume that is expected to be heated is larger than the length and depth of the excitor row but less than the depth and length of the two outer rows. The width of the heated zone is equal to the separation of the two outer rows, that is 10 ft.

The length expected to be heated is equal to the length of the excitor row plus 66 percent of the row separation at each end. This gives an effective heated length of (7.5+0.66*5*2)≈14.1 ft. Similarly, the expected depth of the heated zone is equal to the depth of the excitor row plus 66 percent of the row separation below the tips of the excitor electrodes. This gives a heated depth of (20+0.66*5)=23.3 ft. This gives a heated zone volume of approximately 3,285 cu. ft or 122 cu. yd.

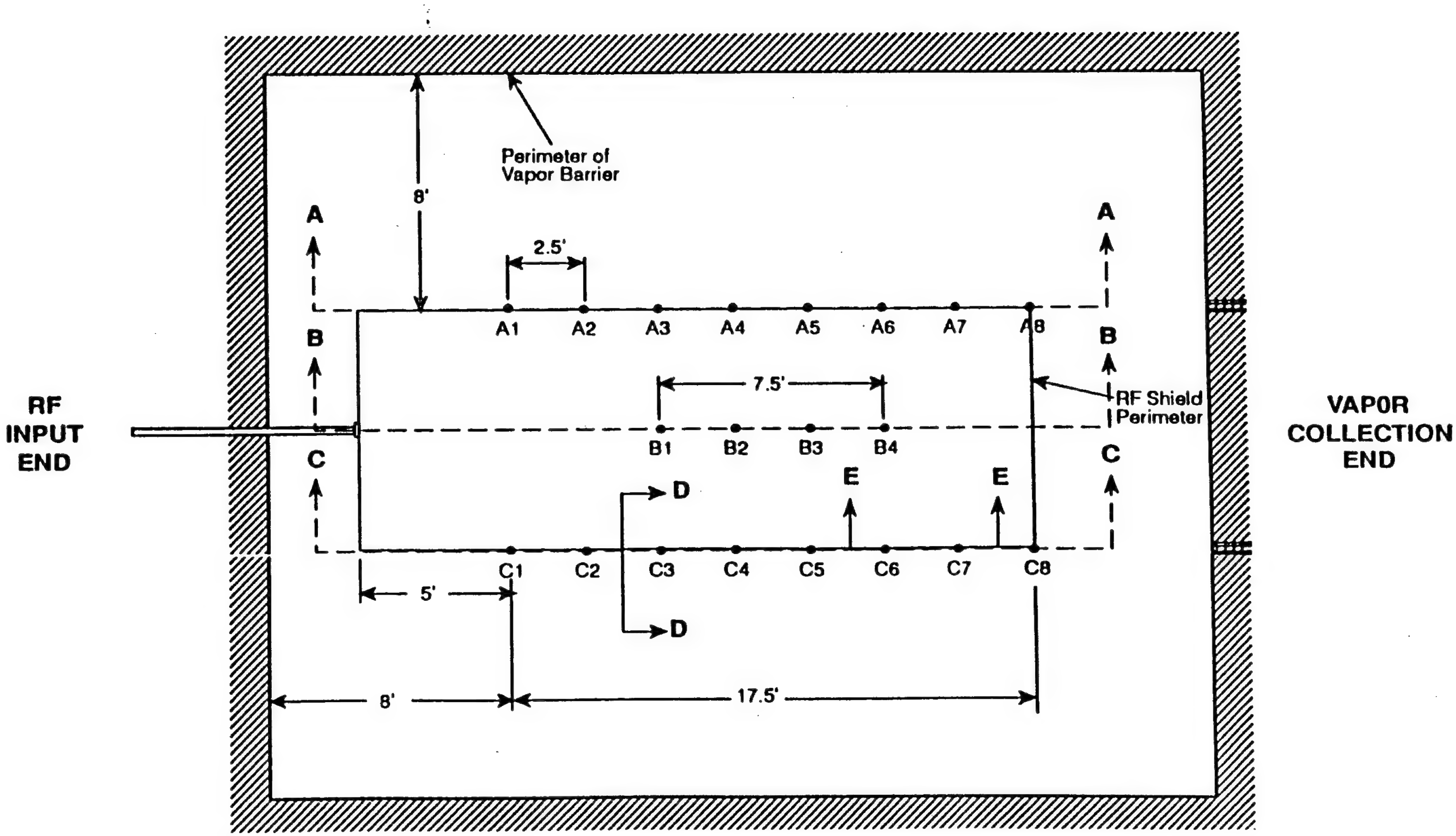


Figure 7. Surface-Level Plan View of the Array (Electrode Locations Shown by •).

Thus the volume that the electrode array was expected to heat has a dimensions of:

Width:	10 ft
Length:	14.1 ft
Depth:	23.3 ft

2. Estimate of Heating Time

Previously, the energy required to heat one ton of soil was estimated as a function of soil moisture content. The RF energy varied between 120 to 190 kW-hr/ton of soil when the soil moisture varied between 10 to 20 percent. The soil moisture content at site S-1 varied between 9 to 26 percent. The heating time for the soil may be estimated by using the higher value for energy requirement corresponding to a moisture content of 20 percent.

The weight of the soil volume which is expected to be heated is approximately 165 tons. Thus the energy required is 31,350 kW-hr. If the RF power source works continuously at the rated output of 40 kW, it will take 33 days to heat the soil to the desired temperature of 150°C. But because the source will not operate at its rated capacity nor will it work continuously, the actual time required will be longer than 33 days.

A practical operating rate of the power source might be in the range of 70 to 80 percent of its rated capacity, or 28 to 32 kW. It was planned to shut down the RF power source three times every 24 hours to take temperature measurements. Each shut down was expected to last 30 to 60 mins. Thus power feed interruptions of 1.5 to 3 hrs in every 24-hr period were planned. Thus the energy output per day from the power source after accounting for planned interruptions and operating rate is 590 to 720 kW-hr/day. Thus a practical heating time for the soil treatment zone would be 44 to 54 days.

3. System Design Overview

Implementation of the RF technology for soil remediation requires two major subsystems; the RF heating system, and the effluent containment, collection, and treatment (ECCT) system. The RF heating system's purpose is to heat the soil to the required temperature range in the most efficient manner possible. The main components of the RF heating system are the RF power source, the coaxial transmission line, the matching network, the electrode array, the RF shield and RF chokes. The purpose of the ECCT system is to collect and treat the effluents generated during decontamination of soil in an environmentally benign and efficient manner.

A conceptual layout of the RF system configuration is shown in Figure 8. This figure shows all the major components of the heating system and how they are configured in the overall system. The electrode array determines the size of the volume heated by the process. The electrode array had three rows of vertically emplaced electrodes. The width of the array was 10 ft, length 17.5 ft and depth of 20 to 29 ft. The depth of the central row of electrodes was 20 ft while that of the outer rows was 29 ft. A RF shield was placed over the electrode array to mitigate RF radiation from the heated zone. The RF power was generated by the RF power source and conveyed over a co-axial cable to the array through two matching networks and a RF choke. The purpose of the matching networks was to optimize power transfer from the source to the array. These networks contain active and/or passive inductive and capacitive components which were adjusted during heating to optimize power transfer.

A vapor barrier is shown in the plan view. The purpose of the vapor barrier is to help control fugitive emissions from the site and to control the infiltration of air into the heated zone from the surface. The upper surface of the vapor barrier was covered with a thermal insulation blanket to minimize heat loss.

Gas collection lines leave the array and convey the hot gases to an on site vapor treatment system. Hot gases comprise of air, steam and vaporized contaminants present in the soil. Gases are collected from four places by means of application of a vacuum: the two outer rows of electrodes and from two horizontal perforated lines placed on the surface below the vapor barrier. A RF choke is used on the gas pipeline leaving the system to prevent the conduction of RF currents along the surface of the pipeline.

The temperature of the soil was measured by means of thermocouples mounted inside the electrodes and by periodically inserting fiber optic temperature measurement probes into thermowells. The thermocouple cables leaving the two outer rows of electrodes were connected to a data logger. The thermocouples in the excitor row and the fiber optic thermometer in the thermowells were read after shutting down the RF power.

The vapor treatment system utilized in this demonstration consisted of a propane flare in which the entire collected gas stream was burnt. The vacuum required for the collection and transport of the gases was provided by means of compressed air ejectors. The motive air used for the operation of the ejectors was mixed with the collected gases.

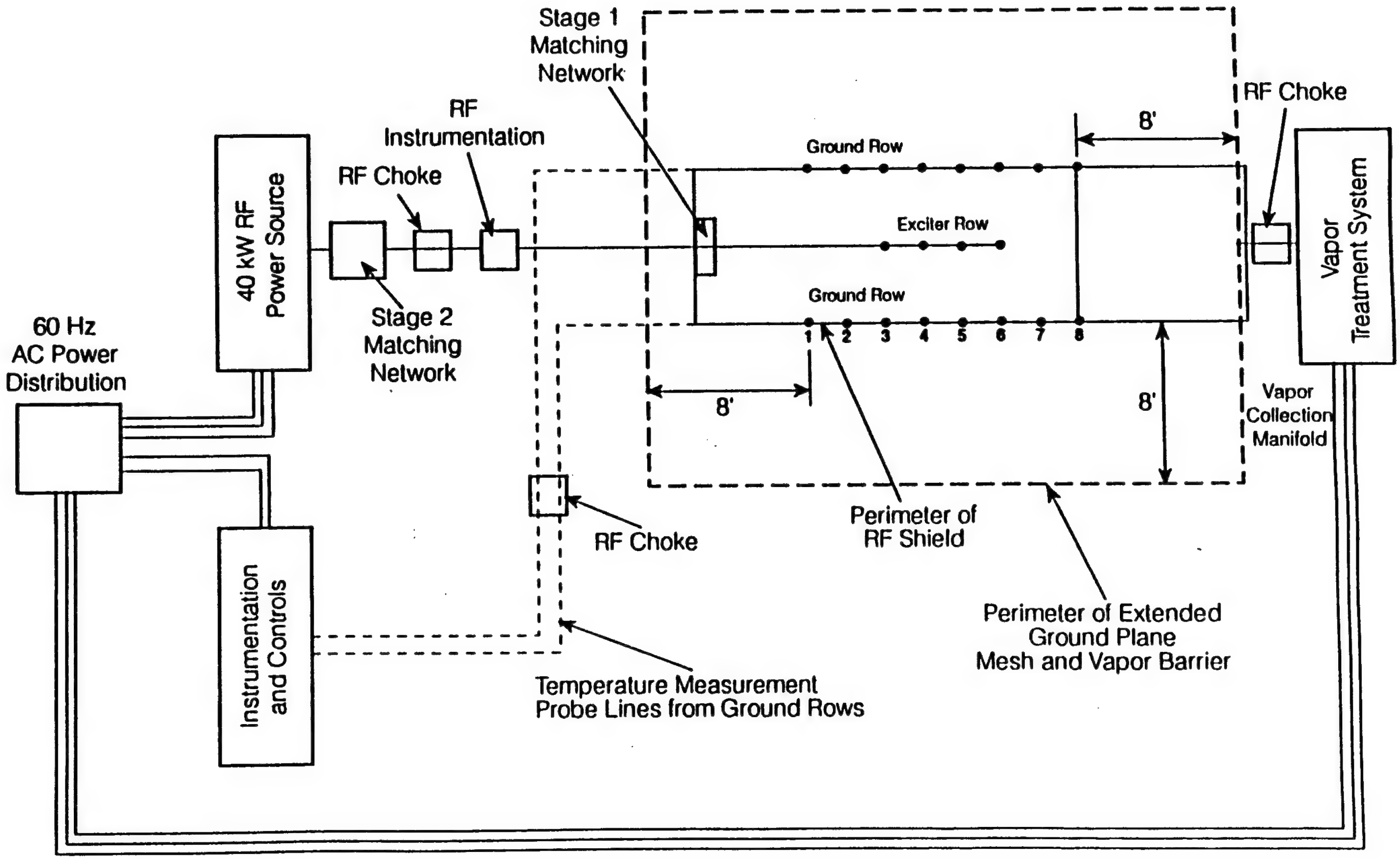


Figure 8. Conceptual Layout of the Demonstration System.

4. Electrode Array Design

Figure 7 (Page 32) is the surface level plan view of the electrode array. It shows the three rows of electrodes and their spacing. The three vertical sections AA, BB and CC of the array are displayed in Figure 9. In this figure the dotted lines show the electrodes in the two ground rows of electrodes, A1,C1,...,A8,C8. The depth of these electrodes was 29 ft. All of these electrodes except the ones at the four corners were perforated and connected to the gas collection system. The bottoms of these electrodes were capped. All the electrodes in the two ground rows were made from 2-in. diameter schedule 40 aluminum pipe. At the top the perforated ground electrodes were connected with each other within a row to form a gas collection manifold. Thermocouples were placed inside selected electrodes to obtain temperature data.

The excitor electrode of Section BB are illustrated by the solid lines in Figure 9. There were four excitor electrodes. The two outer electrodes were 3 in. dia. Type K copper tube and the two inner electrodes were 2 in. diameter type K copper tube. The depth of these electrodes was 20 ft. The tops of these electrodes were connected together by means of copper tube and Tees. A single RF feed line of 3 in. diameter was provided to the excitor electrode manifold. At the bottom of the excitor electrodes a brass sphere was welded to the electrode in order to increase the surface area of the tips of the electrodes in order to reduce the current density concentration at the tips. The sphere at the bottom of electrodes B1 and B4 had a diameter of 5.5 in. The sphere at the bottom of electrodes B2 and B3 had a diameter of 4.5 in. None of these electrodes were used for gas collection.

All the boreholes were drilled by means of hollow stem augers which were required to obtain undisturbed core samples of the soil while drilling for the electrode bore holes. As a result the ID of the bore hole was considerably larger than the OD of the electrodes. The annular gap had to be backfilled with either native material or else another material having similar clay, silt and sand levels. The soil borings obtained from the site contained large pieces of gravel mixed with plastic clay which was difficult to re-insert in the annular space between the electrode and the borehole. So the bore holes were backfilled with a mixture of clay and red "ball park sand". The clay was obtained from a materials yard and the sand was obtained from a local sand pit. The mixture was four volumes of the sand to one volume of the clay.

Figure 9 illustrates the outline of the RF shield which was made from corrugated aluminum sheeting curved to form a semi-circular cylinder of diameter 9 ft. The shield is described in another section later.

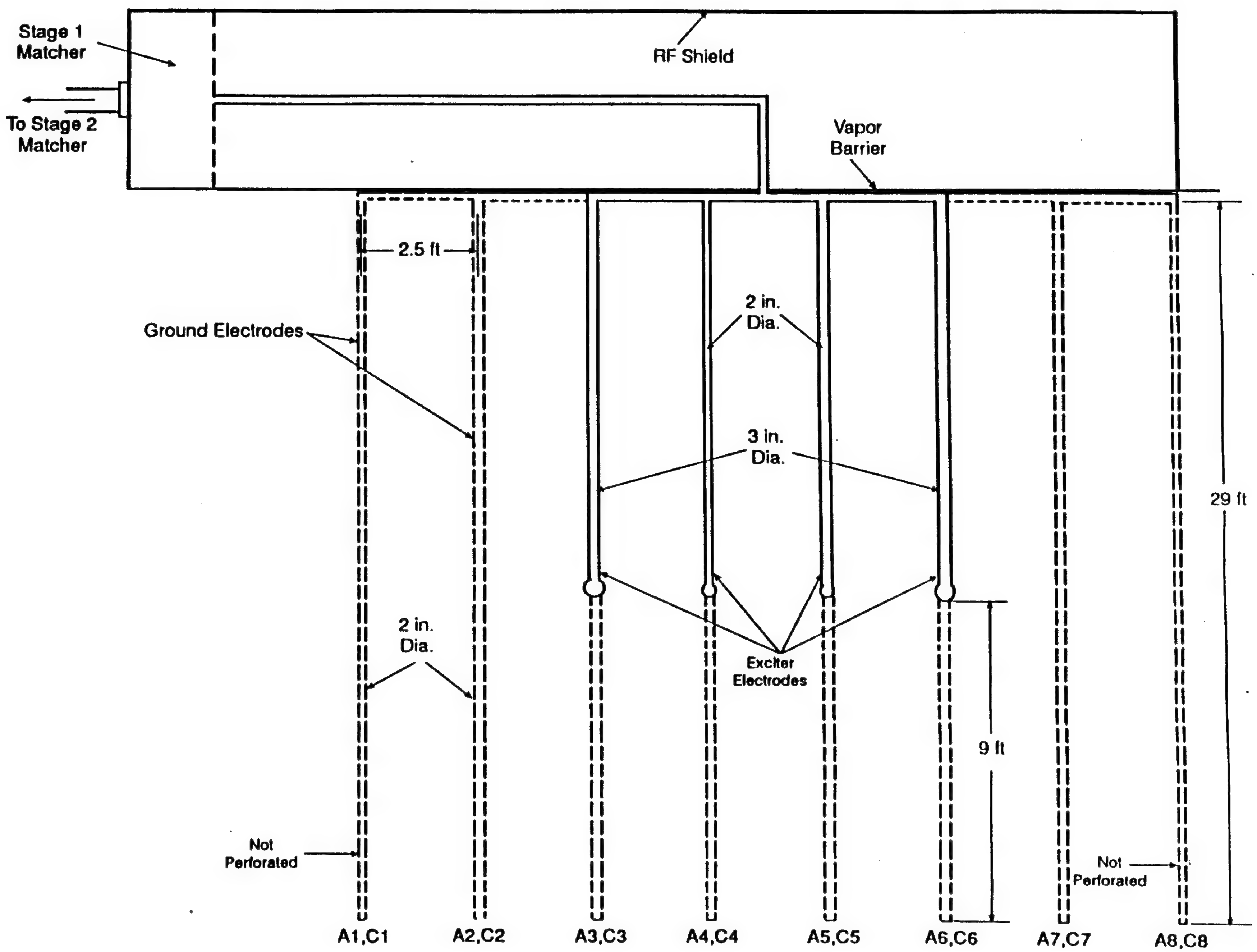


Figure 9. Vertical Sections ., BB, CC of Electrode Array.

TABLE 8. ELECTRODE ARRAY DIMENSIONS--DESIGNED VS. IMPLEMENTED

Dimension	Planned	Implemented
Depth of outer rows, ft	29	29
Depth of center row, ft	24	20
Length of the outer rows, ft	17.5	17.5
Length of the center row, ft	7.5	7.5
Separation of two outer rows, ft	10	10

The design of the electrode array was changed in the field after the bore holes were drilled and the water table was discovered to be shallower than anticipated. The original design of the array required the excitor electrodes to be 24 ft deep. But the depth of the electrodes was reduced when the shallow water table was discovered. Table 8 compares the original dimensions of the array to that actually implemented.

Figure 10 illustrates a typical Section DD of the array. This figure shows the construction of the array near the surface. The drawing illustrates the locations of: the horizontal gas collection line place on the surface, the pea gravel fill, the contaminated soil overpack, the aluminum bus bar connecting the outer electrodes, the extended ground plane wire mesh, the vapor barrier, the thermal insulation and the bentonite-filled trench to make a seal between the soil surface and the vapor barrier.

Figure 11 illustrates a typical section EE. This view illustrates the interconnection of any two adjacent gas-collecting electrodes in the two outer rows. The tops of most of the electrodes in the ground row were connected to the branch leg of a Tee. The straight runs of the Tees were interconnected by means of short pieces of flexible silicone rubber hose clamped to pipe nipples threaded into the Tee.

A short piece of aluminum angle was also welded to each Tee. These were welded such that they bent towards the outside of the array. The electric bus bar was bolted to each of these angles to

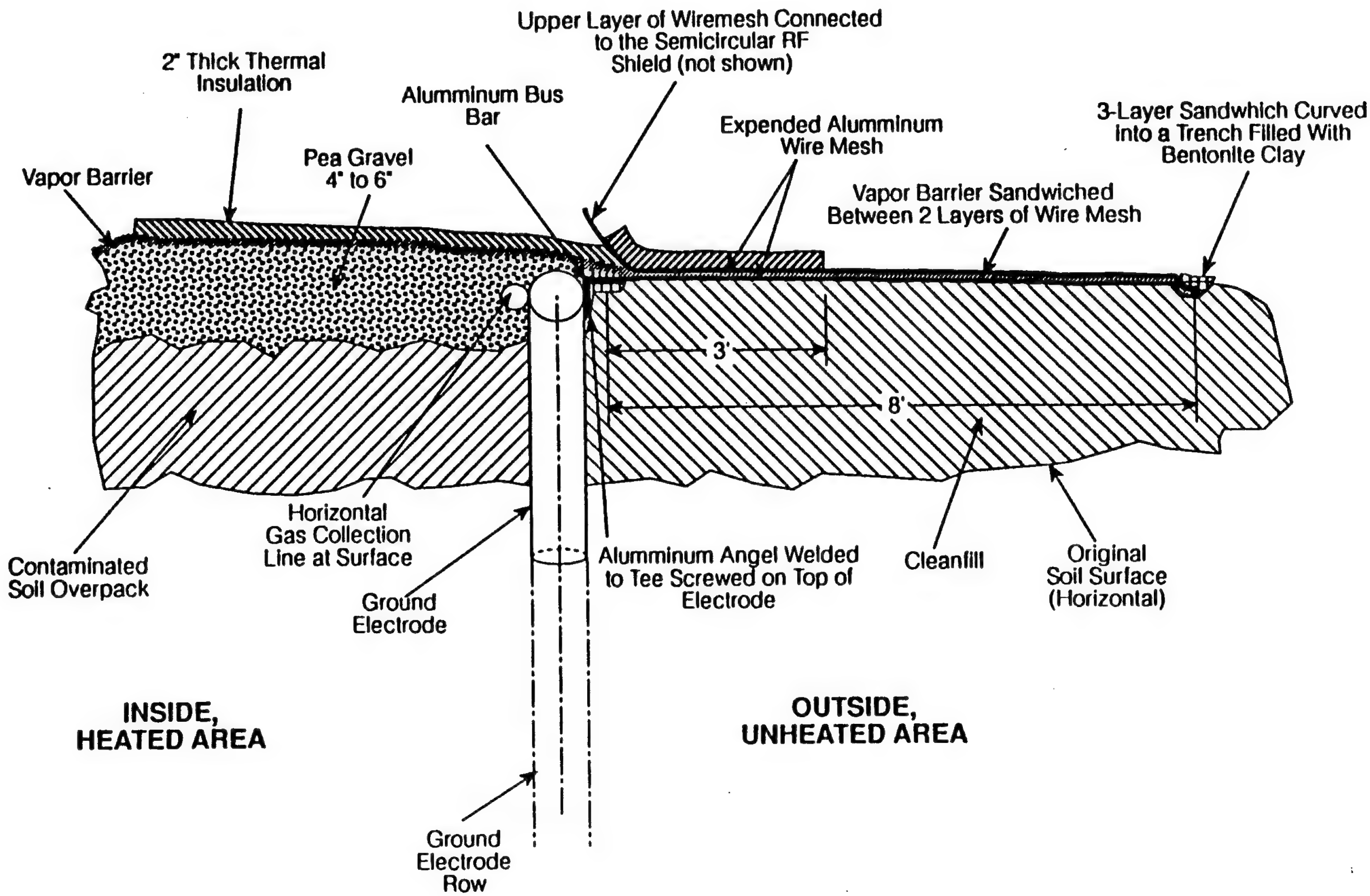


Figure 10. Transverse Section DD of the Array Near Soil Surface.

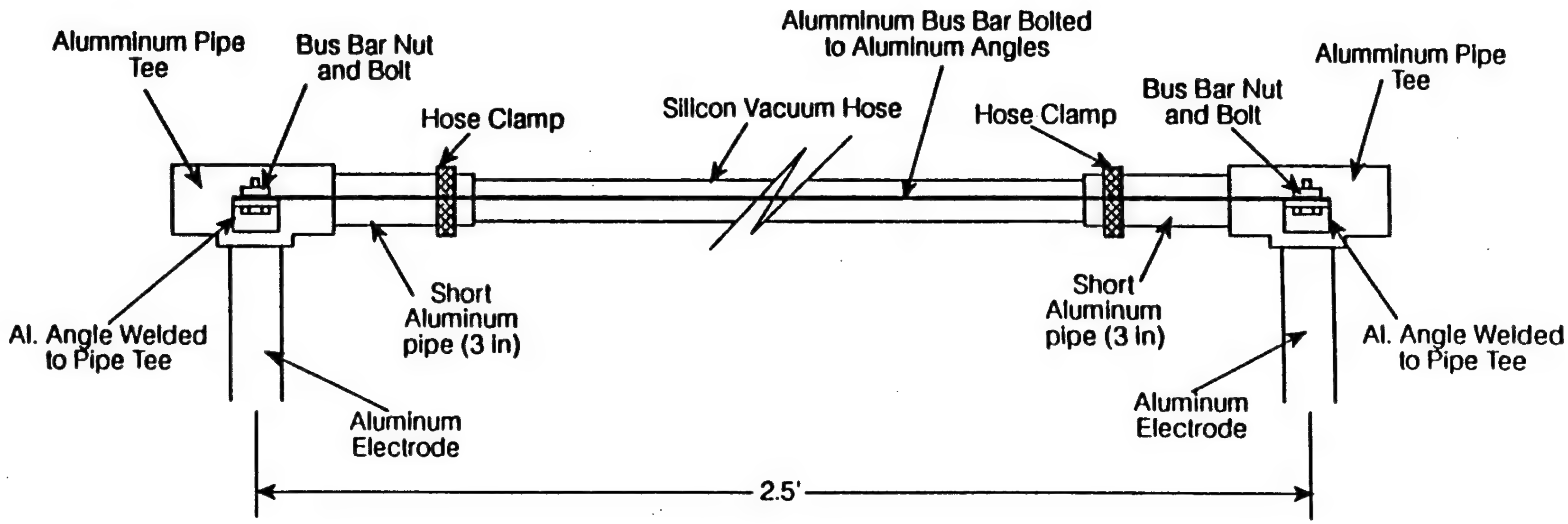


Figure 11. Typical Section EE: Electrode Interconnection in Ground Rows A and C.

provide the current path from electrode to electrode. The bus bar was made from a strip of aluminum sheeting 2.5 ft long, and 3 in. wide.

5. RF Shield

Figure 12 illustrates the RF shield. The RF shield consisted of a semi-circular cylinder lying on its side. It was made by screwing together in the field pre-curved sheets of corrugated aluminum. The finished length of the shield was approximately 22 ft; 9 ft diameter. The ends of the cylinder were made from aluminum sheet. The height of the shield was 4.5 ft. Means of continuously venting the interior of the shield were provided. The vented air was passed through activated carbon drums.

6. Vapor and Gas Collection Lines

Figure 13 illustrates the network of pipes used to collect hot gases from the soil surface and at depth. The main gas line was split into four legs, each with its own ball valve and a vacuum gauge. The gases were collected from two perforated horizontal surface gas collection lines as well as from each of the two outer electrode rows. The surface gas collection lines were made from aluminum pipe. All lines were heat traced once they left the heated soil area. The ball valves were provided to adjust the vacuum level in each leg of the collection system.

7. Temperature Instrumentation

The soil temperature was measured by means of thermocouples attached to the inner walls of selected thermocouples and by inserting fiber optic thermometers into thermowells installed in bore holes located between the electrode rows.

Table 9 gives the distribution of the electrodes which were installed inside the electrodes. In both the ground row electrodes the thermocouples were installed at a depth of 1, 12, 24, and 29 ft. In the excitor row the thermocouples were installed at a depth of 1, 10, 20 ft.

In the original design the location of the thermocouples was selected to provide temperature data at four horizons of interest below the soil surface. These horizons were: the 1-ft depth, the mid point of the excitor electrodes, the tips of the excitor electrodes and the tips of the ground electrodes. However, during field installation of the electrode array the design of the excitor electrodes had to be changed because a shallow water table was encountered, contrary to expectations. At this time it was not possible to change the location of the thermocouples already

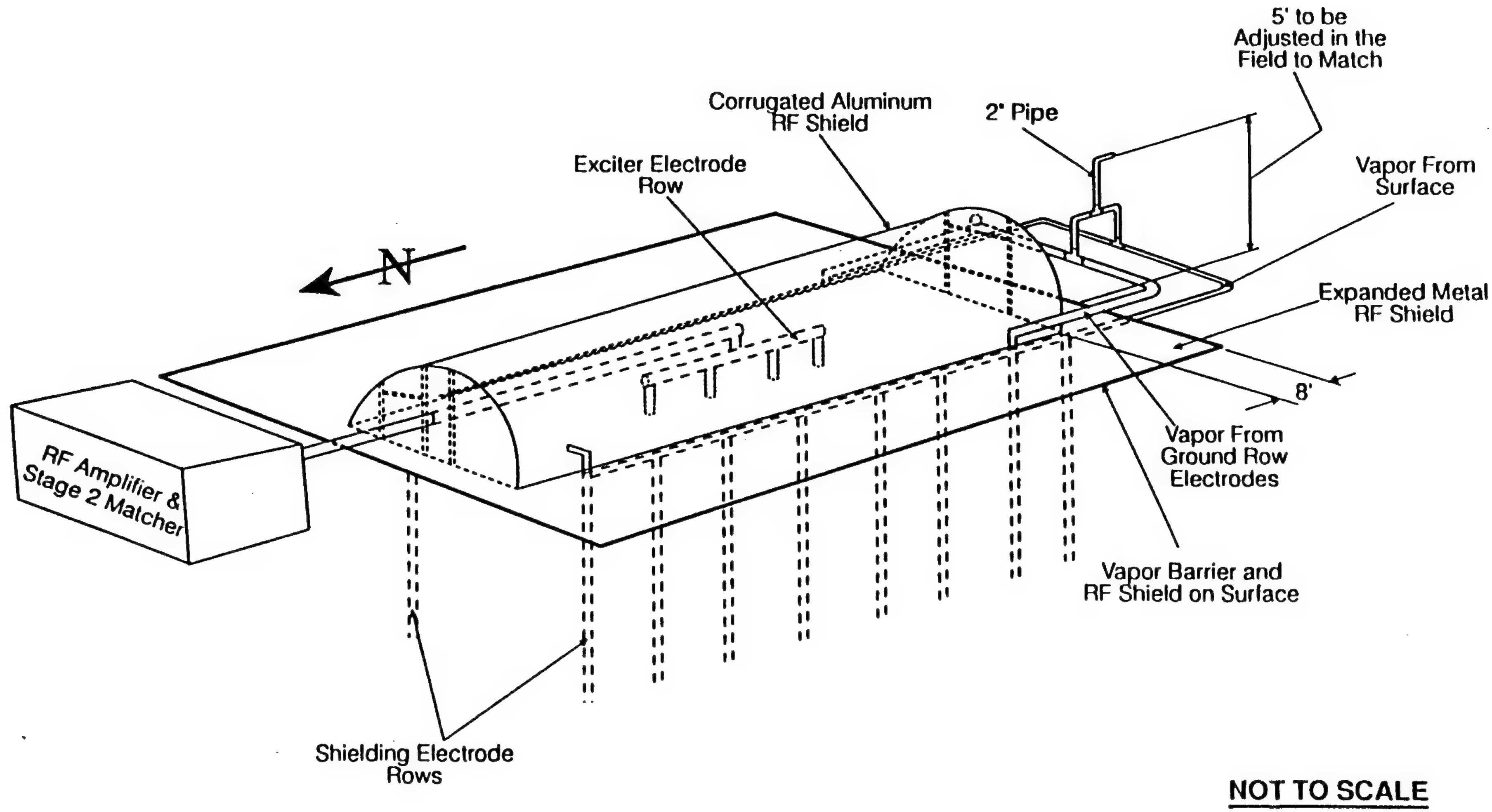


Figure 12. RF Shield (Stage #1 matcher enclosed under arch)

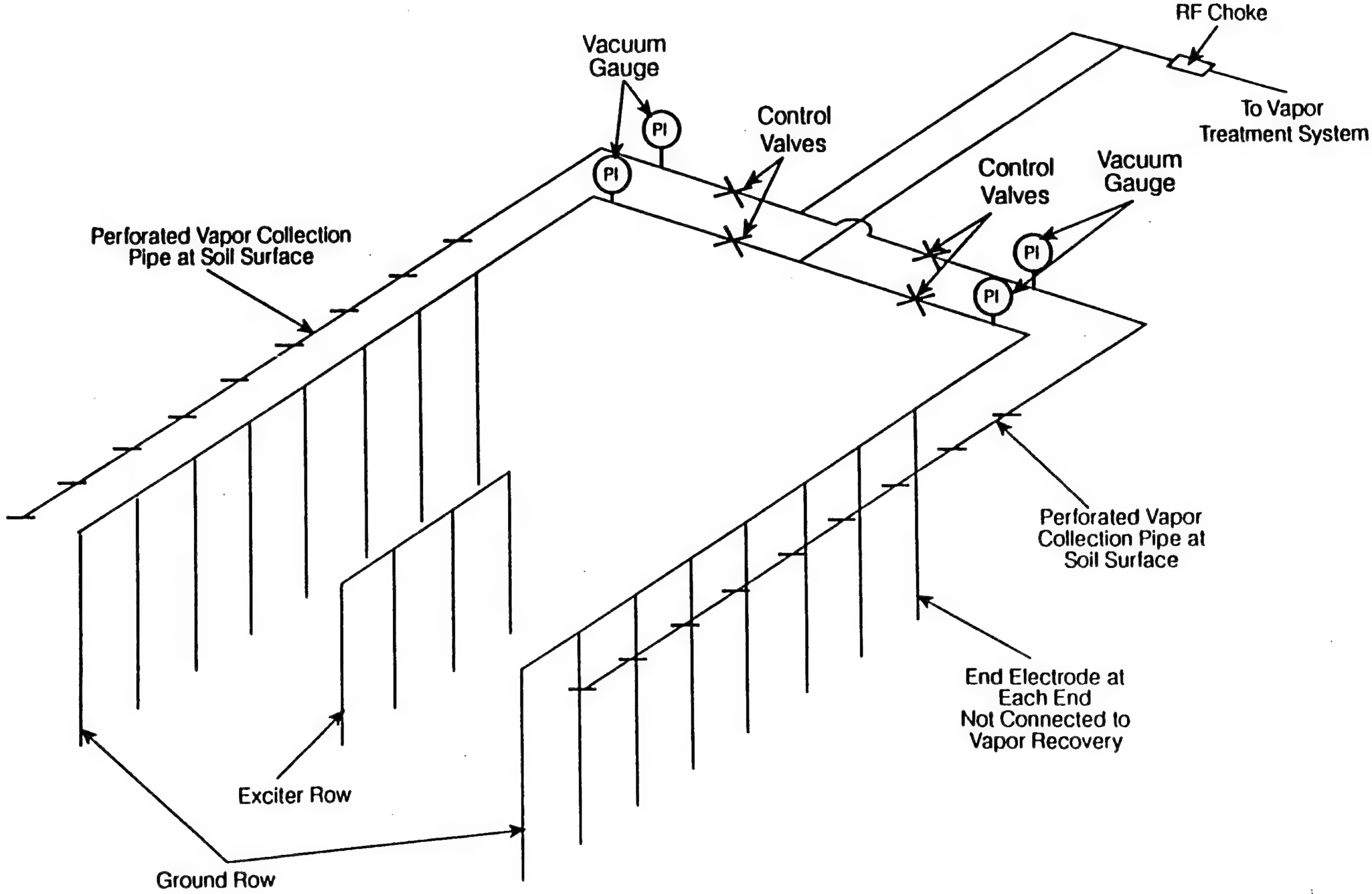


Figure 13. Vapor Collection Manifold.

TABLE 9. THERMOCOUPLE DISTRIBUTION INSIDE ELECTRODES

	Ground Row A	Ground Row B	Excitor Row C
No. of Thermocouples	11	16	12
Electrodes with T/Cs	A2,A3,A4	C1,C2,C3,C4,C6	B1,B2,B3,B4
Total No. of Electrodes	8	8	4
Depths of T/Cs, ft	1, 12, 24, 29	1, 12, 24, 29	1, 10, 20

installed in the ground electrodes. Thus the four temperature measurement horizons are not true horizontal planes as is evident from Table 9.

The location of the thermocouples in the array is presented graphically in Figures 14 through 16. The thermocouple location is marked with a X. Figure 17 illustrates the method of thermocouple attachment to the electrode wall. All thermocouples were Type K with a 1/16 in. SS 304 sheath. The junctions were ungrounded. The sheaths on these thermocouples were long enough so that the transition from sheath to wire occurred above ground. The thermocouple wires were run inside conduit to minimize RF pick up. A separate conduit was not necessary. For the excitor electrodes the thermocouple sheaths were run inside the tubular RF bus supplying power to the center row. For the two ground rows the thermocouples were run inside the vapor collection conduit attached to the tops of the ground electrodes.

All the thermocouples from the ground electrodes were connected at the surface to a data logger through a multiplexer. Data was recorded by the data logger once every 4 hours. The data were available for inspection on a PC screen which was refreshed every 2 min. The measurement of temperature in the excitor row required the RF power to be switched off. Then the thermocouple wires were plugged into a hand held thermometer and the temperature of the 12 measurement points in the excitor electrodes was manually entered into the project log book. These readings were taken once every 8 to 12 hours.

Temperature of the soil in the region between the electrodes was taken by inserting a fiber optic probe into thermowells placed

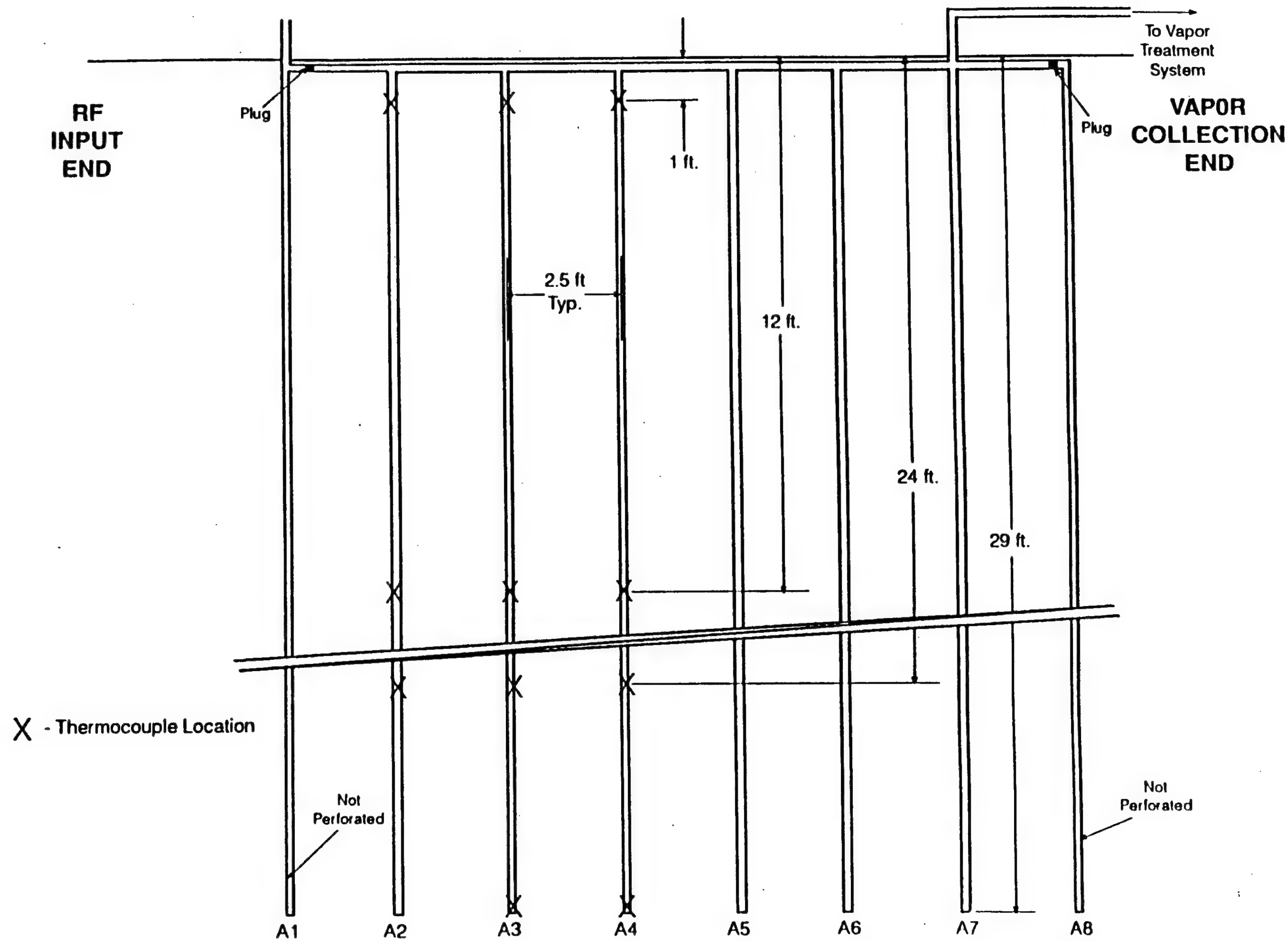


Figure 14. Thermocoι Locations in Plane AA.

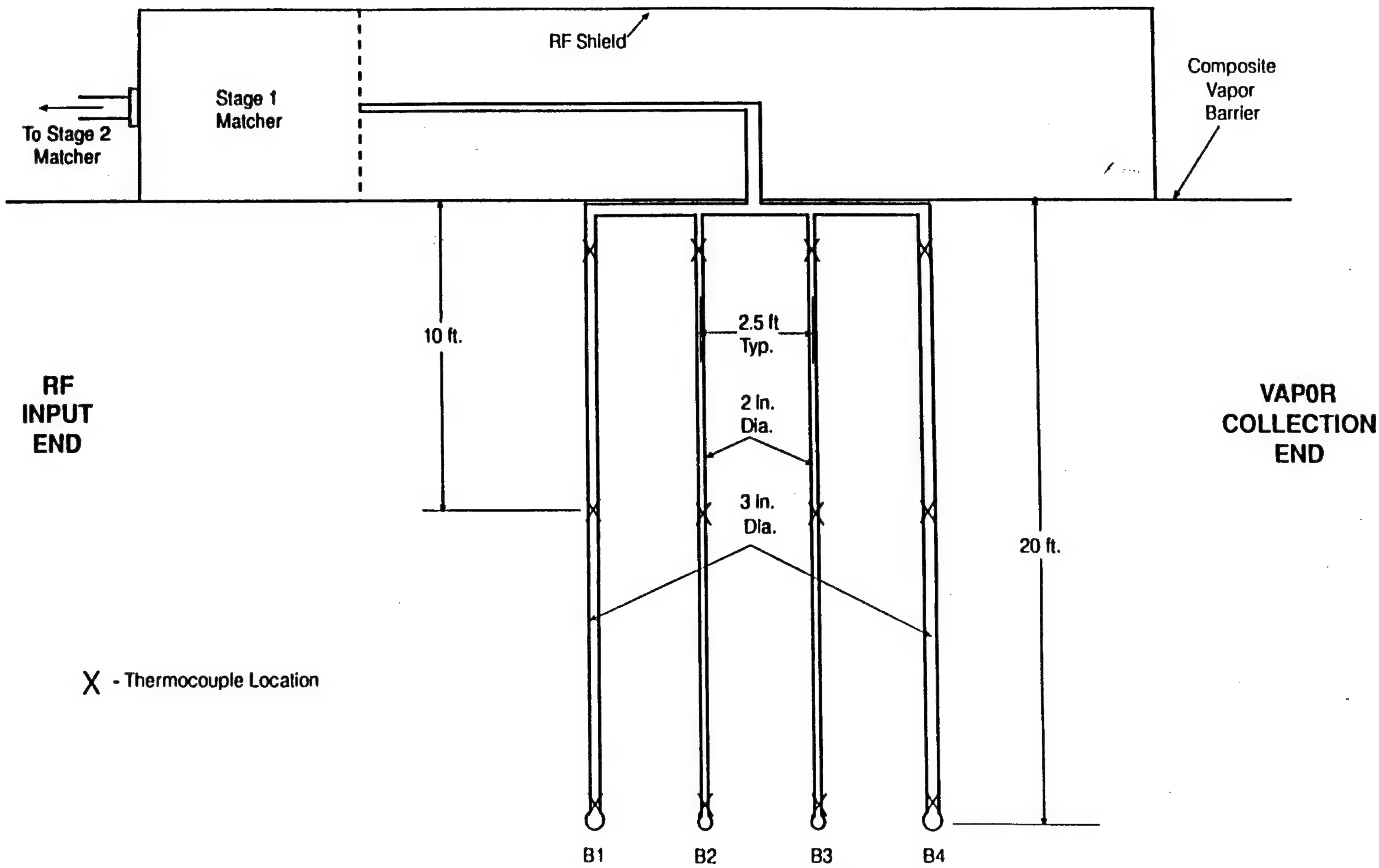


Figure 15. Thermocouple Locations Plane BB.

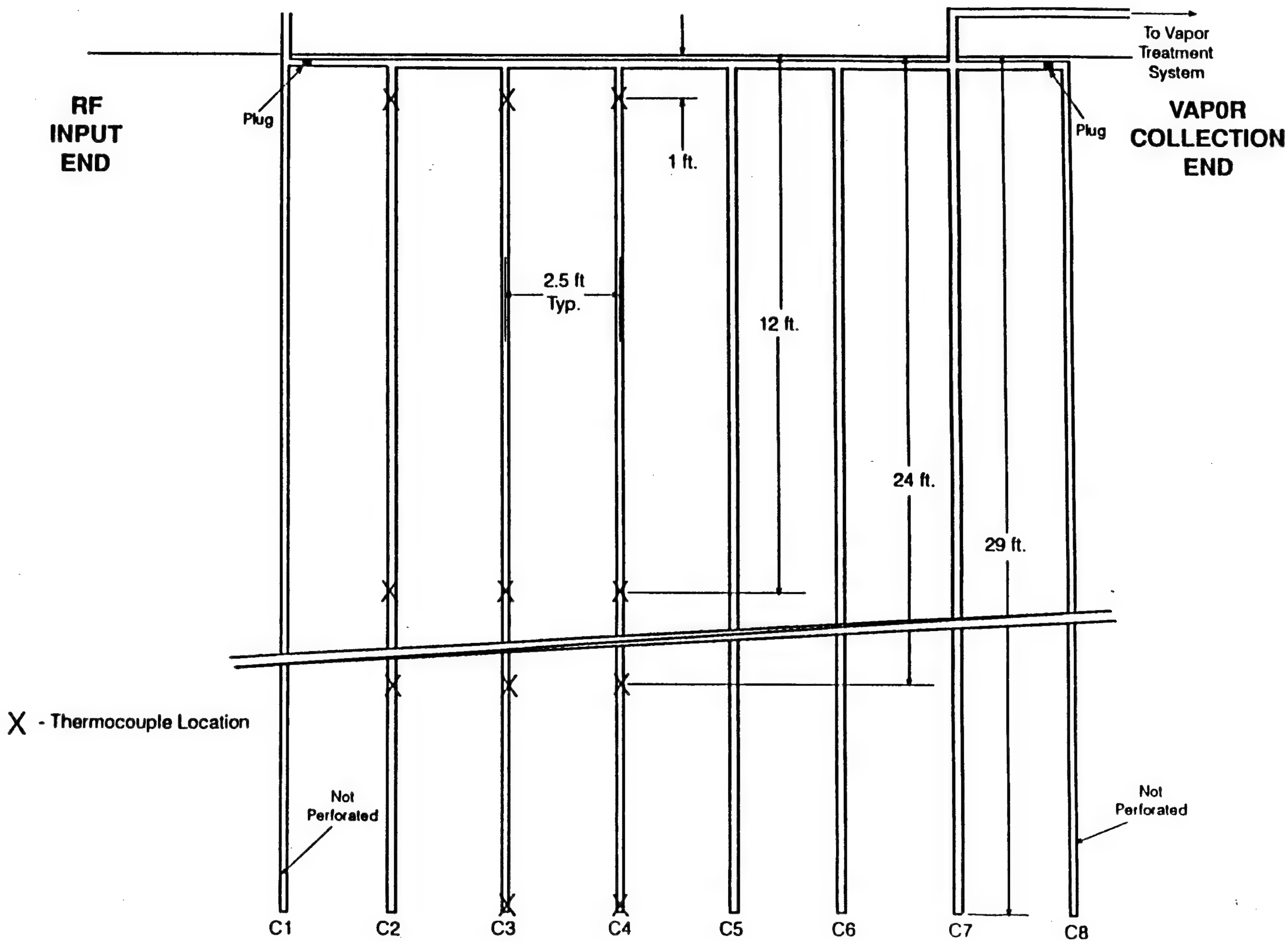


Figure 16. Thermocou-˙ Locations in Plane CC.

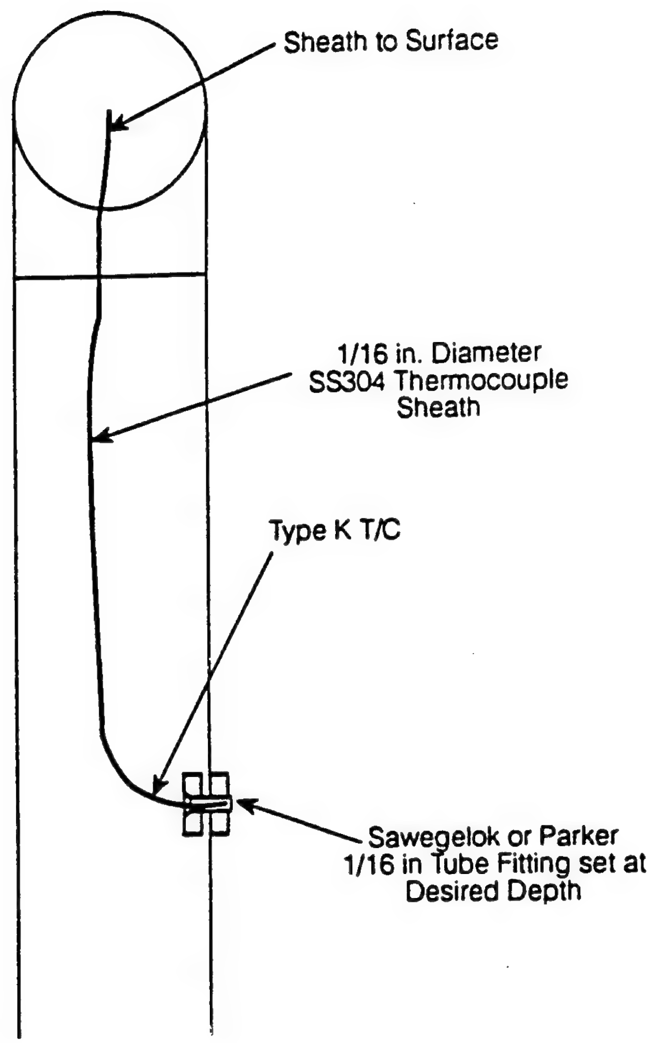


Figure 17. Typical Thermocouple Installation Within Electrode.

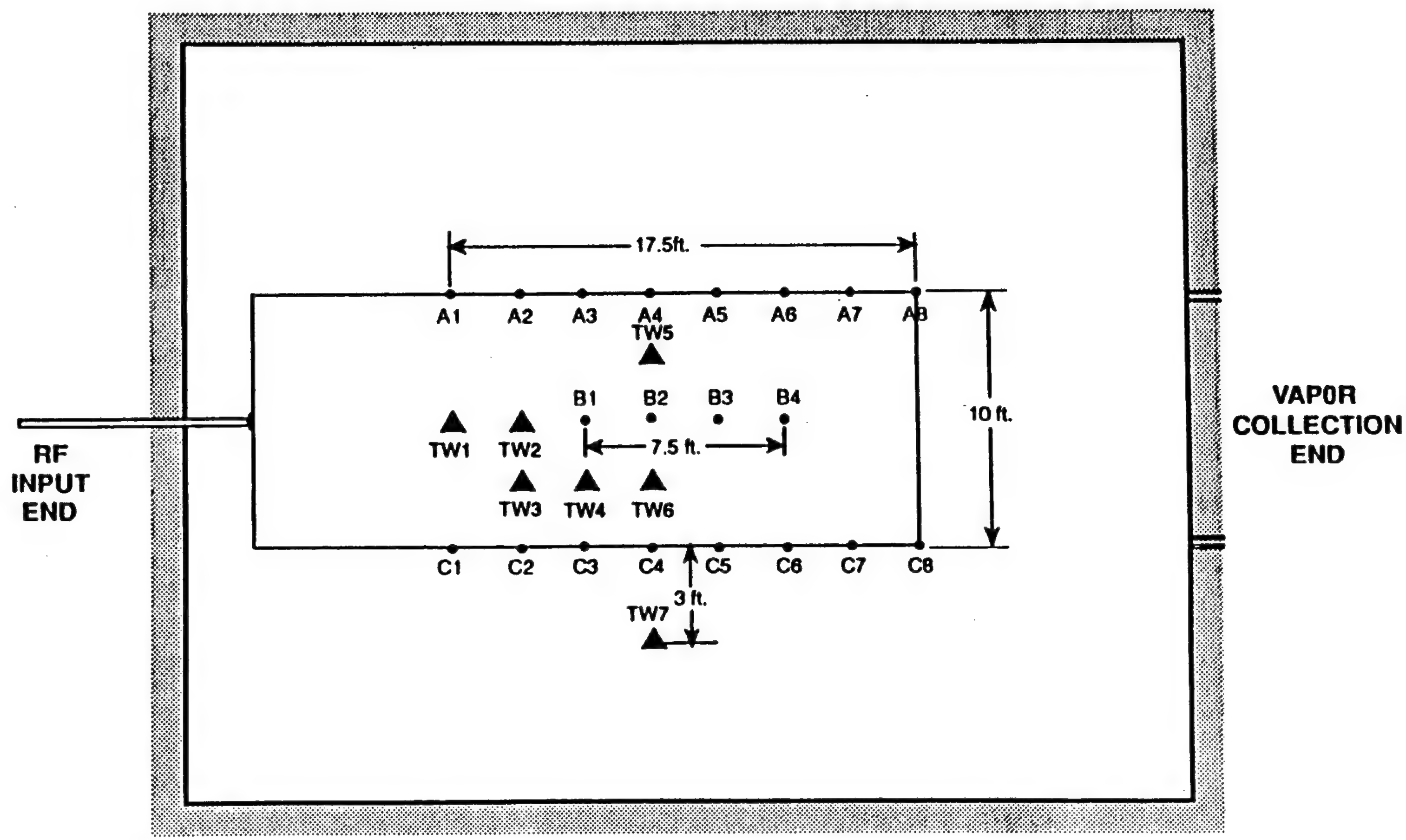


Figure 18. Surface-Level Plan View of the Array. Electrode (•) and Thermowell (▲) Locations.

in bore holes. Figure 18 shows the locations of the seven thermowells marked TW1 through TW7. In each thermowell location a bundle of teflon tubes sealed at the bottom was placed in a borehole. The tubes in the bundle were of different lengths so that the temperature could be measured as a function of depth. In TW1 through TW6 there were six tubes in each bundle. These tubes were installed such that their bottoms terminated at depths of 1, 12, 24, 29, 31 and 34 ft below the heated surface. These depths were selected to correspond to the depths of thermocouples in the electrodes. These thermowells had two additional depths of 31 and 34 ft. to investigate what effect if any there was below the electrode array. Thermowell TW7 had three tubes installed at depths of 12, 24 and 29 ft. Thermowell TW7 was installed approximately 3 ft outside the array directly opposite electrode C4. The temperature at the bottom of each tube was measured by inserting the fiber optic probe in each tube one at a time. The bottoms of each plugged tube was filled with a small amount of silicone oil to help facilitate temperature equilibration between the thermowell and the fiber optic probe. The fiber optic temperature measurements of all the thermowells were made and recorded once every 24 hours. However, four probes were left in selected thermowells and these could be measured whenever desired. Measurements taken by fiber optic probes do not require shutting down of the RF power.

VI. DEMONSTRATION OPERATION

A. SYSTEM START UP

The RF heating system was turned on at Noon on April 3, 1993. Prior to this time, the vapor collection system had been operational for several days, collecting gases and vapors from the soil volume which was at ambient temperature. Initially power to the array was applied at low levels in the range of 0-5 kW. During this time the system was stabilized and measurements of radiated E (electric) and H (magnetic) fields were made in the vicinity of the demonstration system. The purpose of these measurements was to ensure that there were no unsafe levels of radiated fields. Another set of measurements was made at the low input power level for assessing near and far field radio frequency interference (RFI).

The input power was gradually increased over the next two days until on April 5, 55 hours after start up, the input power reached the rated capacity of power source. After attaining the rated power operation, additional measurements were made to assure that there was no radio frequency interference as a result of the demonstration project. RFI measurements were made near the test site, and at distances of 0.5 and 1 mile from the array.

The safety measurements were made at least three times every day during the course of the demonstration.

B. CHRONOLOGY OF EVENTS

Table 10 summarizes the highlights of the demonstration experiment. A detailed summary of events culled from the project log books is presented in Appendix A. The central volume of soil between electrodes (A3,C3,C6,A6) reached an average temperature of 100°C in the period April 22 to April 24, 1993. The average temperature in this zone reached the target temperature of 150°C by May 15, 1993. However, on May 18, 1993, RF power matching difficulties were encountered which were to stay with us for the remaining duration of the experiment. As it will be discussed in Section 7, these were due to extreme hot spots located in the excitor row which caused melting of the copper electrodes. As the temperature data will show, no substantial increase in temperature of the heated zone occurred after the matching difficulties started.

Attempt to continue heating of the soil after May 18 were made in the hope of maximizing the volume of soil inside the array which gets heated to 150°C. The heating experiment was terminated on June 3, at Noon.

Table 10. Chronology of Selected Events

Date	Event
4/3/93	Started Heating
4/6/93	Excitor Row reaches 99° C
4/19/93	Excitor Row reaches 100° C
4/22 to 4/24/93	Central volume defined by (A3,C3,C6,A6) reaches an average temp. of 100° C
5/6 to 5/11/93	Temperature at measurement point B2A started increasing faster than the other points. 253° C on 5/6; 740° C on 5/11
5/15/93	Central volume defined by (A3,C3,C6,A6) reaches an average temp. of 150° C
5/18/93	RF power matching difficulties start
5/30/93	Tracer injection experiment was performed
6/3/93	Heating was terminated

C. DATA RECORDED AND PARAMETERS MONITORED

1. RF Power Delivery System:

During the course of the demonstration project the following measurements were made regarding the operation of the RF system:

- Forward and reflected power at the array (upstream of the Stage 1 matcher)
- Net input power was calculated by difference of the forward and reflected power
- Vector voltmeter reading: V_a, V_b and phase angle
- Forward and reflected power as measured at the output of the RF power source

The above measurements were recorded in the project log book at least once every 2 to 3 hours of operation

The following parameters were monitored by the operators:

- Settings on the RF power amplifier
- Reflected and forward power as measured at the power

source with suitable adjustments to the Stage 2 matching network to maintain zero reflected power

- Monitoring of the vector voltmeter readings

The above parameters were monitored on a semi-continuous basis. All the necessary gauges and controls were arrayed at the operator's work bench.

Once in every 8 hour shift, the operator would survey the RF equipment with a portable E and H field probe to assure that any radiation from the equipment was at safe levels.

2. Soil Temperature Data

The following measurements were made once in 24 hours:

- Measurement of the thermowell temperature by manually inserting fiber optic probes into each thermowell. There were six thermowell locations inside the electrode array each containing 6 thermowells. One thermowell was outside the array and its temperature was monitored by the data logger.

The following measurements were made once every 8 to 12 hours:

- Measurement of the temperature from the 12 thermocouples installed in the excitor electrode row. These measurements were made during shift changes after shutting down the RF power input to the soil.

The following measurements were made once every 4 hours:

- The thermocouples in the two outer row of electrode, the ground rows, were logged automatically by the data logger once every four hours. This included the measurement of thermowell TW7 temperatures also In addition, the operator manually wrote down the temperature readings from the PC display once every 2 to 3 hours.

In addition to the above measurements, the ground row temperatures were monitored on a semi-continuous basis from the PC display where the data was updated every 2 minutes.

3. Vapor Collection and Treatment System

This system was operated and maintained by HALLIBURTON NUS personnel. However, the following data were also recorded by IITRI personnel:

- Vacuum level in each of the four legs of the gas

collection system

- Total flow rate exiting the ejectors and entering the flare
- Flow rate and pressure of compressed air supplied to the ejector system
- Vacuum at the inlet of the ejectors
- Temperature of the heat traced vapor collection lines

VII. DEMONSTRATION TEST DATA

A. SOIL TEMPERATURE DATA

1. Summary

As mentioned in Section 6, in situ heating of the soil was begun on April 3, 1993. Power was initially applied to soil at 16:40 hours. The center row of electrodes reached a temperature of 99°C by April 6 and it reached 150°C by April 19. Figure 19 illustrates the electrode array showing the location of the electrodes and thermowells. Thermocouples were attached to the inner walls of many electrodes to measure temperature as explained in detail in Section 5.

Figure 20 illustrates the average soil temperature within two zones of the electrode array. These zones are referred to as Volume I and Volume II. Volume I is the soil contained within the two outer electrode rows and the center row of electrodes, defined by electrodes (A3, C3, C6, A6). As Figure 20 shows, the average soil temperature in Volume I exceeded 150°C for a number of days. In fact the average in this zone peaked at approximately 280°C. The reason for the high average temperature in this volume was the presence of extreme hot spots that developed along the center row of electrodes which melted the copper tube used for the fabrication of the electrodes. Melting point of copper is 1083°C. As will be shown later, there were large temperature non-uniformities in the transverse direction. For example, while the temperature in the center row reached copper's melting point, the temperature in the two ground rows did not exceed 110°C.

It is estimated that the region defined as Volume I is approximately 56 cu. yd. It should be noted that due to the large temperature range within this zone, every temperature measuring point was not at 150°C. It is estimated that 34 cu. yd. of soil was heated such that every measurement point within it achieved and maintained 150°C for long period (>100 hours) of time.

Figure 19 illustrates a second region of soil called Volume II. This area of the array is outside the central row of electrodes and it is bounded by electrodes (A1,C1,C2,A2). It was anticipated that the energy dissipation in this area would be reduced, and, as anticipated, the average temperature of Volume II was less, in the range of 60° to 70°C. It is estimated that Volume II is 18.5 cu. yd. However, due to symmetry considerations, there is another volume of similar size at the opposite end of the array (bounded by electrodes A7,C7,C8,A8) which probably experienced a similar temperature history. There were no temperature measurement points in the opposite end of the array. Thus total volume where

Figure 19. Electrode Hole and Thermowell Layout
(Plan)

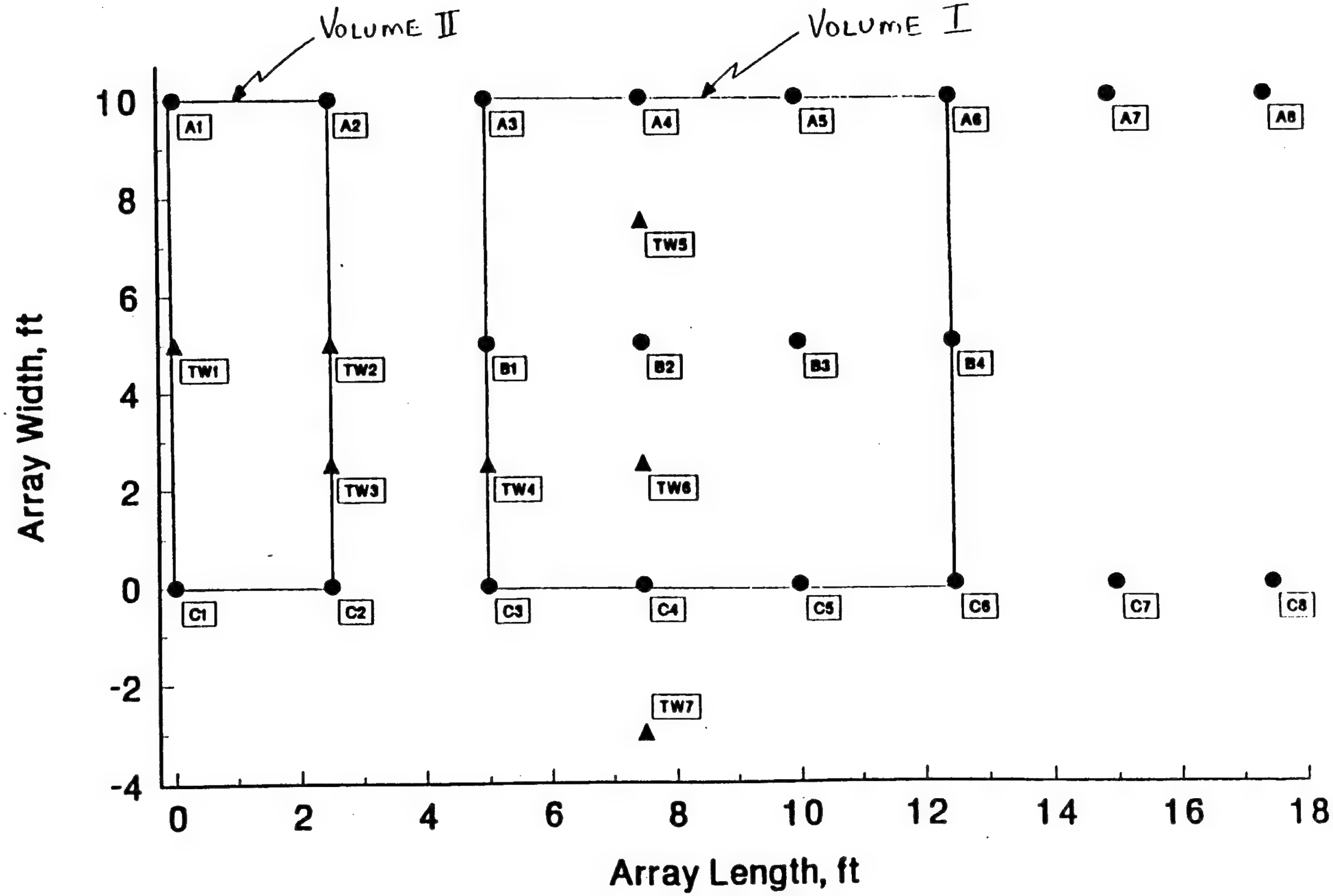
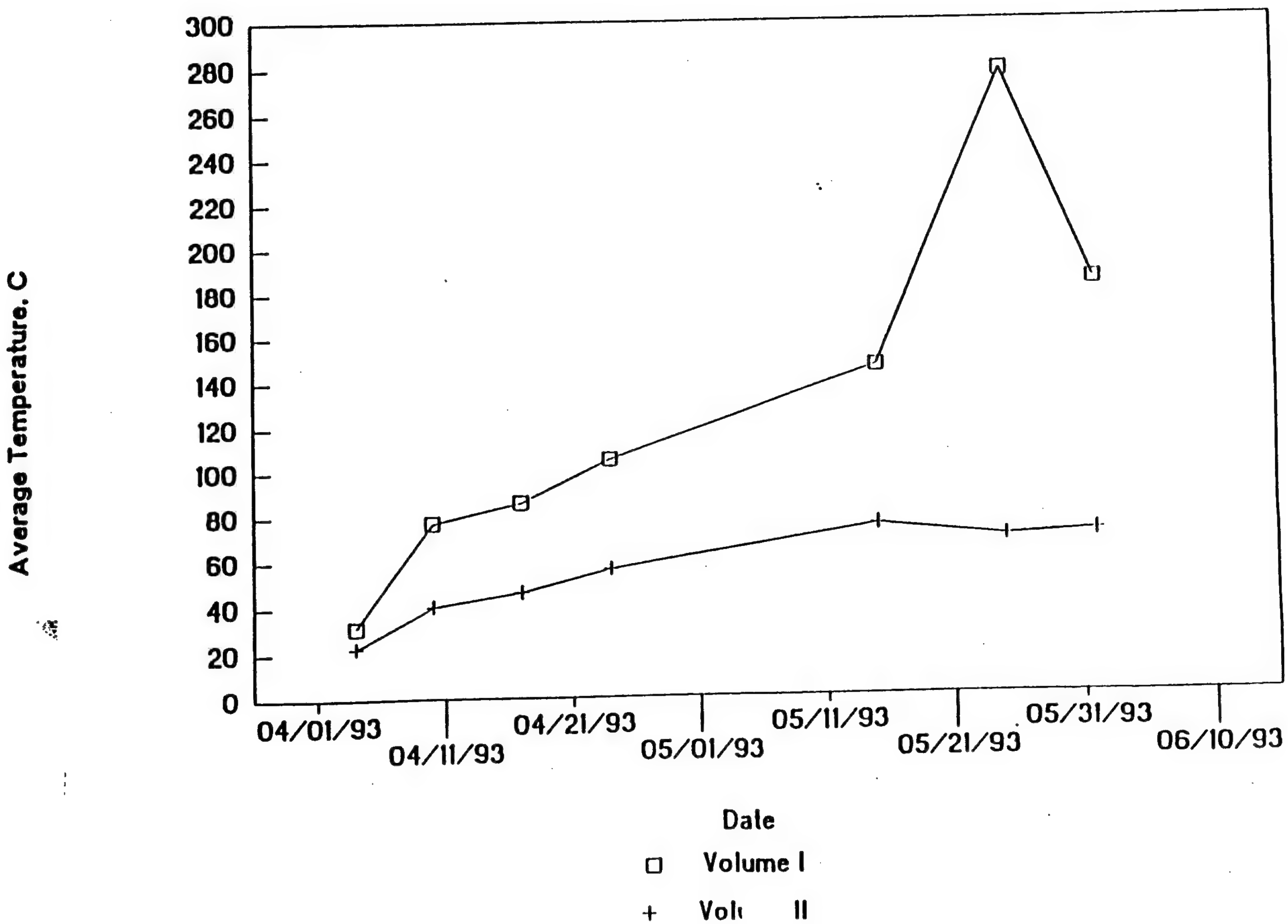


Figure 20

AVERAGE TEMPERATURE IN THE ARRAY, C

(In Volume I and II)



the average temperature was in the range of 60°C to 70°C is estimated to be 37 cu. yd.

There is an intermediate temperature region between Volumes I and II where the average temperature was in the range of 70° to 150°C. It was estimated that the volume of soil where every measurement point equalled or exceeded 100°C is 93 cu. yd. This was estimated by the data presented in the spatial temperature distribution plots presented in a later section herein and in Appendix B.

As mentioned above, there was clear evidence that the copper electrodes in the central row melted due to very high temperatures achieved in this row. Copper melts at 1083°C. Evidence of fused electrodes was recovered during post demonstration demobilization activities from each of the four electrode bore holes B1 to B4. An examination of the complete temperature data presented in Appendix B shows that the melting point of copper was first exceeded at the bottom of electrode B2, as measured by thermocouple B2C. This occurred sometime between May 19 and May 20. The other two measurement points in electrode B2 exceeded the melting point of copper between May 25 and May 26. During the same time, temperature point B3B and B1C also reached or exceeded the melting point of copper. It should be noted that of the 12 temperature measuring points within the center row, only five points reached the melting point of copper and one other fell just short of it by 20°C.

The evidence obtained from the field indicated that every excitor electrode melted. Each of the locations of these electrodes was redrilled with a hollow stem auger. From each hole, electrode pieces were recovered. However, no hole yielded an amount of copper sufficient to account for all the material in an electrode. Due to this it is likely that nearly complete melting of all four electrodes took place. From each hole, nearly intact top section of the electrode was recovered. These varied in length from 6 in. to 24 in.

It is also possible that the thermocouples lost their accuracy once the temperature exceeded 899°C, which is the continuous-duty temperature rating of the thermocouples used in this field experiment. This rating is imposed by the design of the SS 304 sheath used with the Type K, Chromel-Alumel thermocouples used in the field. The chromel alumel thermocouple itself may be used with high temperature sheaths, for measuring temperatures up to 1260°C. SS304 melts in a temperature range of 1400 to 1454°C so it is unlikely that a total failure of the thermocouple sheath occurred.

One possible reason for the overheating of the electrodes in the center row of electrodes was the close proximity of the

electrode tips to the water table. This is a possible reason because RF fields will hunt out and concentrate towards water or other polar fluid if present in the vicinity.

The actual depth to water table inside the heated volume during the course of heating is unknown. However, during site preparation activities, four dewatering wells were installed at the four corners of the array area, outside the perimeter of the vapor barrier. There was a water table monitoring point inside the array. One of the electrode bore holes was used for this purpose until it became necessary to remove the piezometer in order to complete the array. The dewatering wells were operated continuously (barring brief shut downs for maintenance and one power failure) in an attempt to keep the water level depressed.

Water level measurements were made in the central piezometer in the period February 2, 1993 to February 11, 1993. Water level was in the range of 22.47 ft to 23.84 ft below ground surface. In the above mentioned time period water table levels decreased by approximately 1 to 1.5 ft. Dewatering wells were operational during this period.

2. Excitor Row Temperatures

Figure 21 illustrates the average temperature in the excitor (Center row) row of electrodes as a function of time and depth. The temperature was measured in each electrode at three depths-- 1 ft, 10 and at the bottom, at approximately 19.5 ft (shown as 20 ft in the Figures). Complete temperature data of the excitor electrodes is presented in Appendix B along with additional graphs.

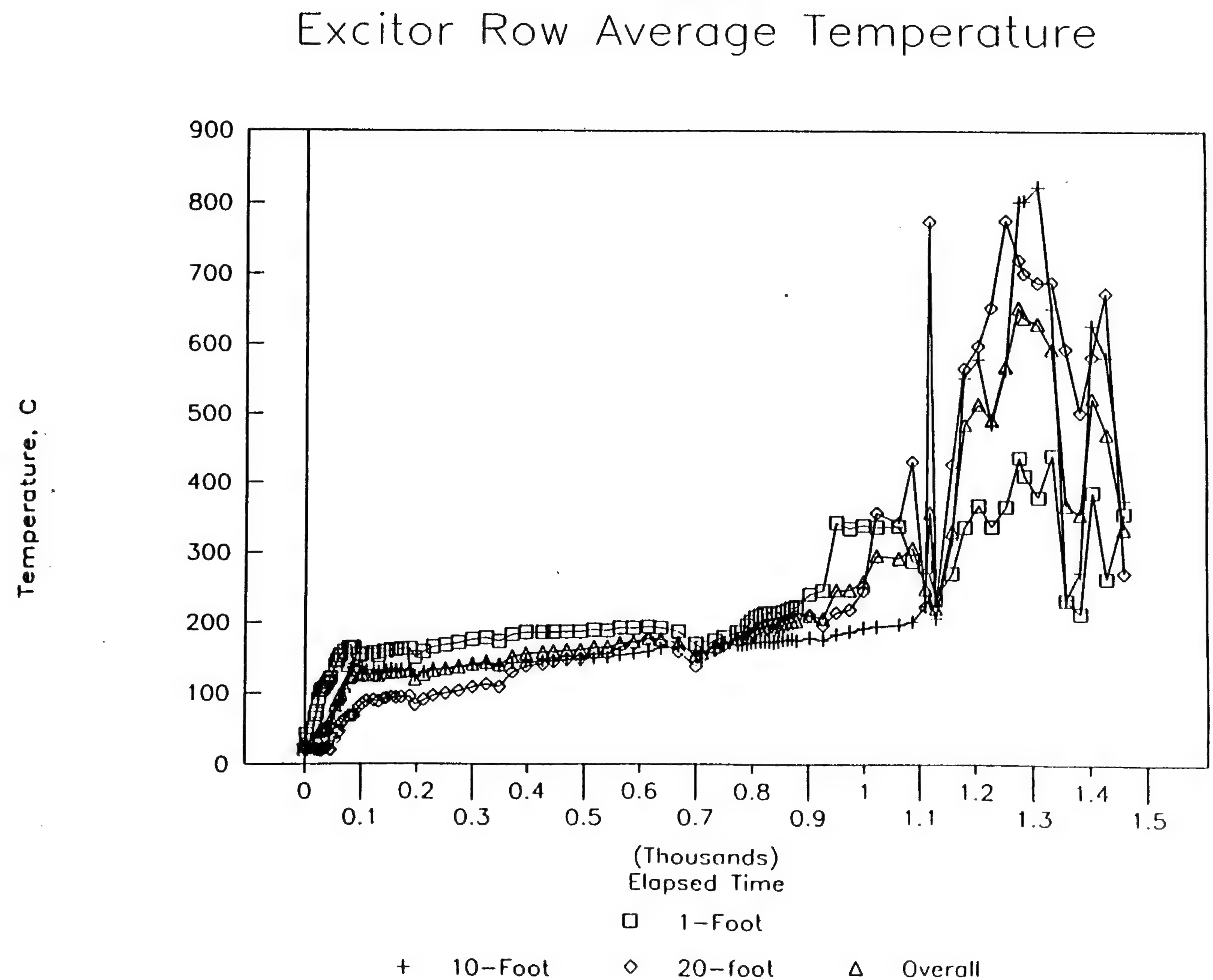
3. Ground Row Temperatures

Figure 22 illustrates the average temperature of the thermocouples inserted in ground row electrodes. The data is presented as a function of time and depth of insertion. The graph also shows the average of those thermocouples measurement points which were opposite the excitor electrodes B1 to B4. As the graph shows, the average temperature of the ground row measurement points did not exceed 100°C. Although the average was maintained in the temperature range of 85 to 90°C for long period of time. There was one measurement point in electrode A4 which exceeded 100°C. Complete data tables and additional graphs of temperature for the ground electrodes are presented in Appendix B.

4. Thermowell Temperatures

Figure 23 illustrates the average temperature as measured in the six thermowells located inside the array. There was a seventh thermowell located outside the array, opposite electrode C4.

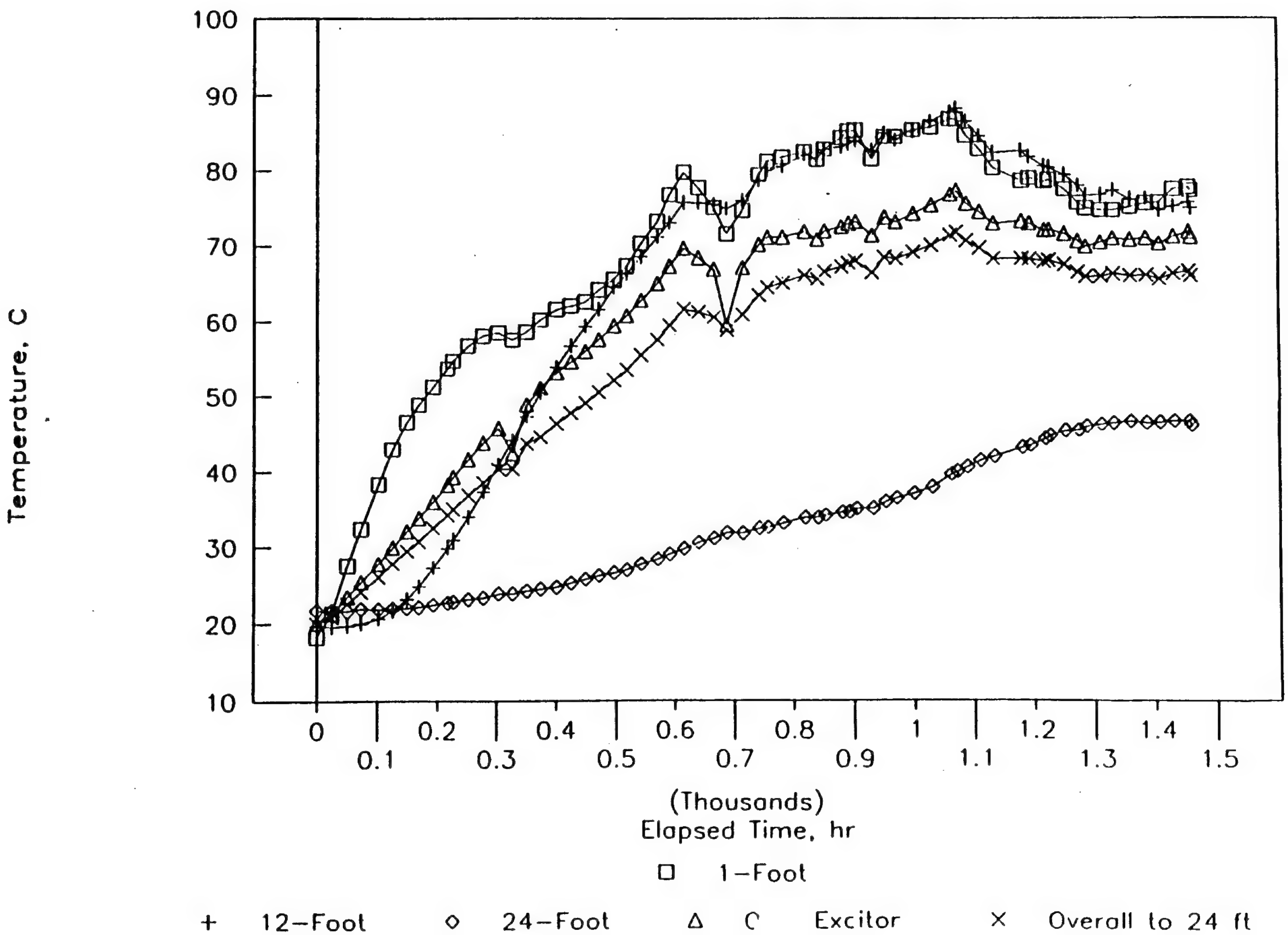
Figure 21



Excitor Row Average Temperature
Temperature, C
900
800
700
600
500
400
300
200
100
0
0
0.1
0.2
0.3
0.4
0.5
0.6
0.7
0.8
0.9
1
1.1
1.2
1.3
1.4
1.5
(Thousands)
Elapsed Time
1-Foot
10-Foot
20-foot
Overall

Figure 22

Ground Rows Average Temperature



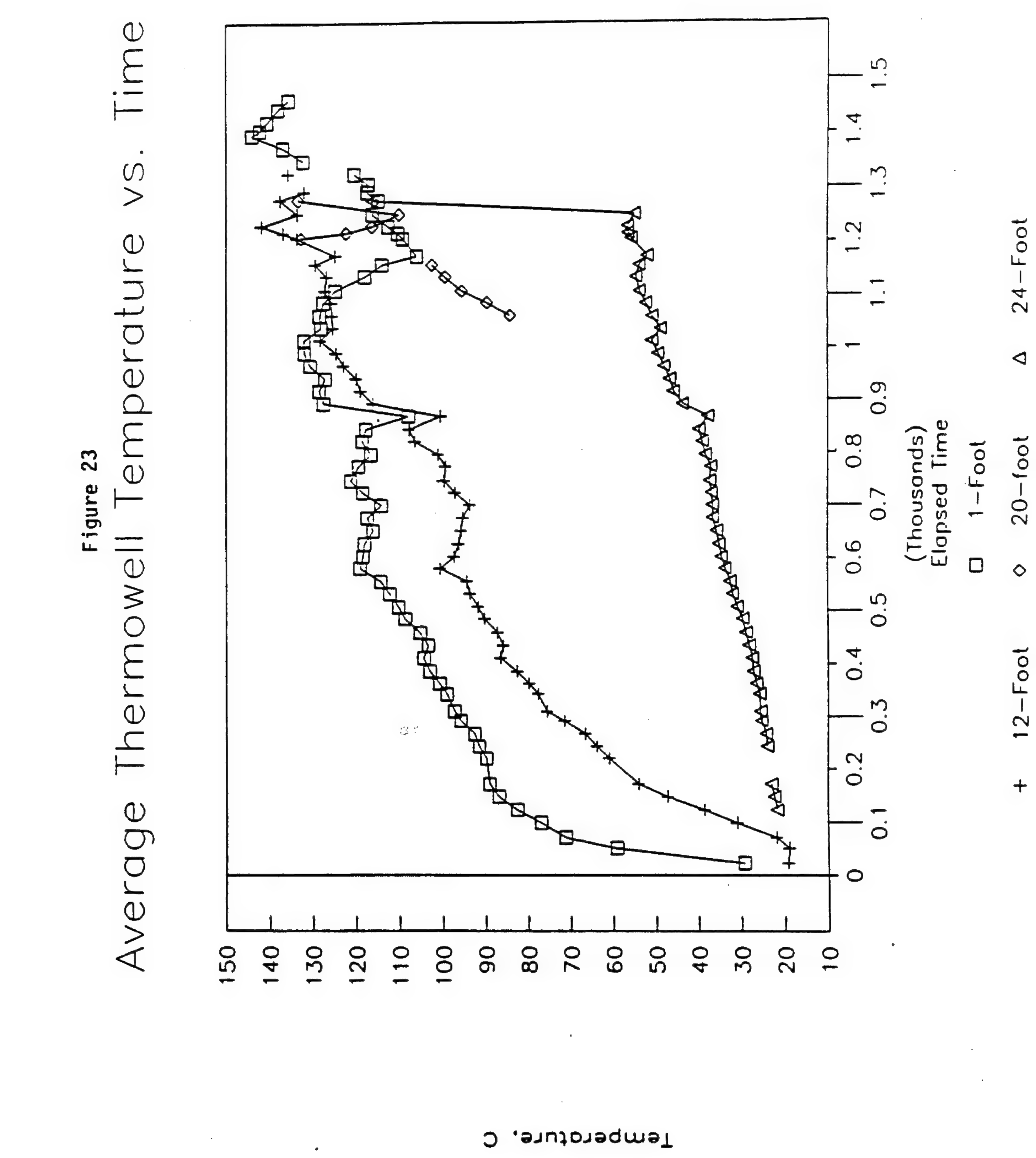


Figure 23
Average Thermowell Temperature vs. Time
Temperature, C
150
140
130
120
110
100
90
80
70
60
50
40
30
20
10
0
0.1
0.2
0.3
0.4
0.5
0.6
0.7
0.8
0.9
1
1.1
1.2
1.3
1.4
1.5
(Thousands)
Elapsed Time
□ 1-Foot
+ 12-Foot
◇ 20-foot
Δ 24-Foot

Figure 19 illustrates the thermowell locations. A detail description of the thermowells was presented in Section 5. As the data show, the average thermocouple temperature at a depth of 1-ft reached 140°C towards the end of the demonstration. Similarly the average at the 12 foot level reached 130 to 140°C range. The 24-foot level reached approximately 50°C. During the course of the test, attempts were made to make measurements at a depth of 20 ft in a thermowell which was inserted to a depth of 24 ft. These data show that the average temperature at the 20 ft level reached almost 130°C. It should be noted that these averages include measurements made in TW1 which is on the edge of the array and it consistently showed temperatures much less than the other thermocouples. TW3 was the other thermowell inside the array to exhibit lower temperatures.

Additional temperature data from the thermowells is presented in Appendix B.

5. Temperature Outside the Array

There was one thermowell, TW7, which was placed in a bore hole three feet outside Ground Row C. This hole was located opposite electrode C4. This thermowell had measurement points at depths of 12, 24, and 29 ft. The data is presented as a function of time and depth in Figure 24. At a depth of 12 ft, a maximum temperature of approximately 65°C was achieved. At a depth of 24 ft. the temperature was on the range of 35 to 40°C at the time of shut down. Appendix B illustrates curves in which the temperature in TW7 is compared with the temperature inside the nearest electrode, C4.

6. Temperature During Cool Down

Figure 25 illustrates the average temperature of the two ground rows as a function of depth and time during cool down. As the curves show, the soil cooling rate was quite small despite the continued operation of the vacuum extraction system.

7. Spatial Temperature Distributions

The spatial temperature distribution in five different vertical planes intersecting the electrode array was plotted. Figure 26 defines the locations of the five vertical planes. These were labelled: LONG, LNGU, TRANS, TRNS, and TRNV. The first two are longitudinal vertical planes aligned with the length of the array. The other three are transverse vertical planes, aligned with the width of the array. For illustrative purposes, the spatial distribution as a function of time for plane TRANS is presented here. The remaining distributions are presented in Appendix B.

Figure 24

OUTSIDE THERMOWELL (TW7) TEMPERATURES

(All Depths)

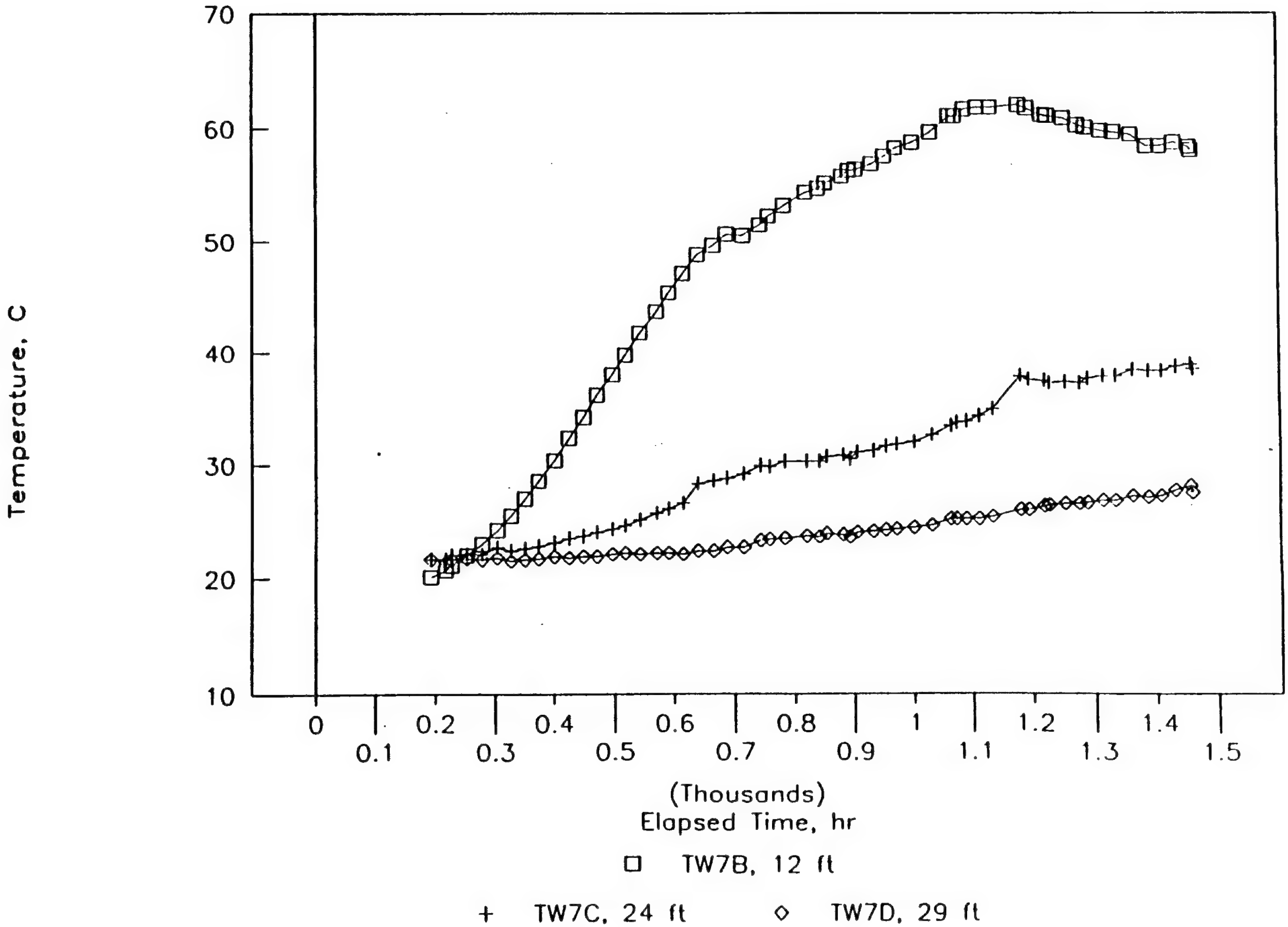


Figure 25

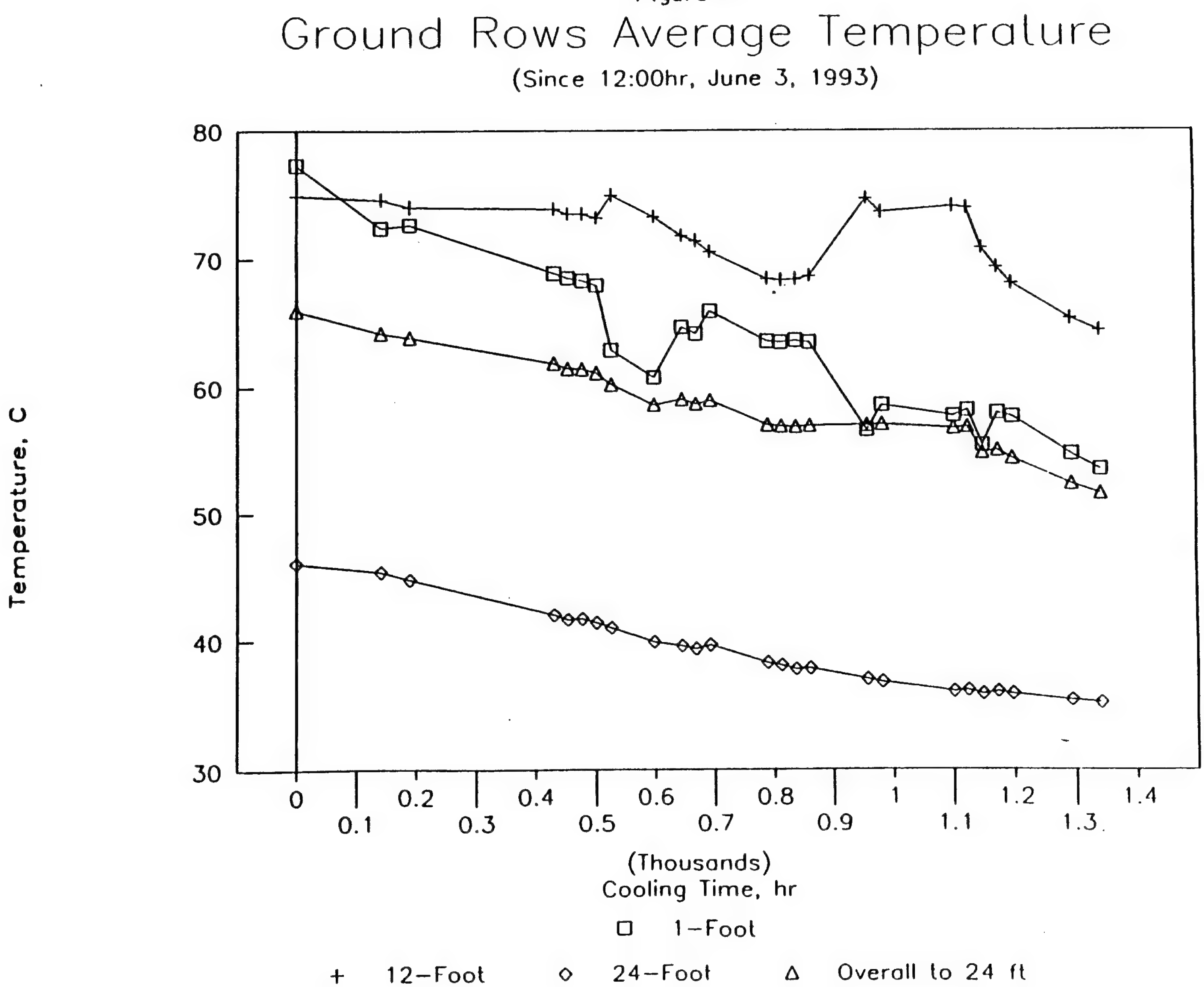

Ground Rows Average Temperature
(Since 12:00hr, June 3, 1993)
Temperature, C
80
70
60
50
40
30
0
0.1
0.2
0.3
0.4
0.5
0.6
0.7
0.8
0.9
1
1.1
1.2
1.3
1.4
(Thousands)
Cooling Time, hr
□ 1-Foot
+ 12-Foot
◇ 24-Foot
Δ Overall to 24 ft

Figure 26. Definition of Vertical Planes for Temperature Distribution
(Plan)

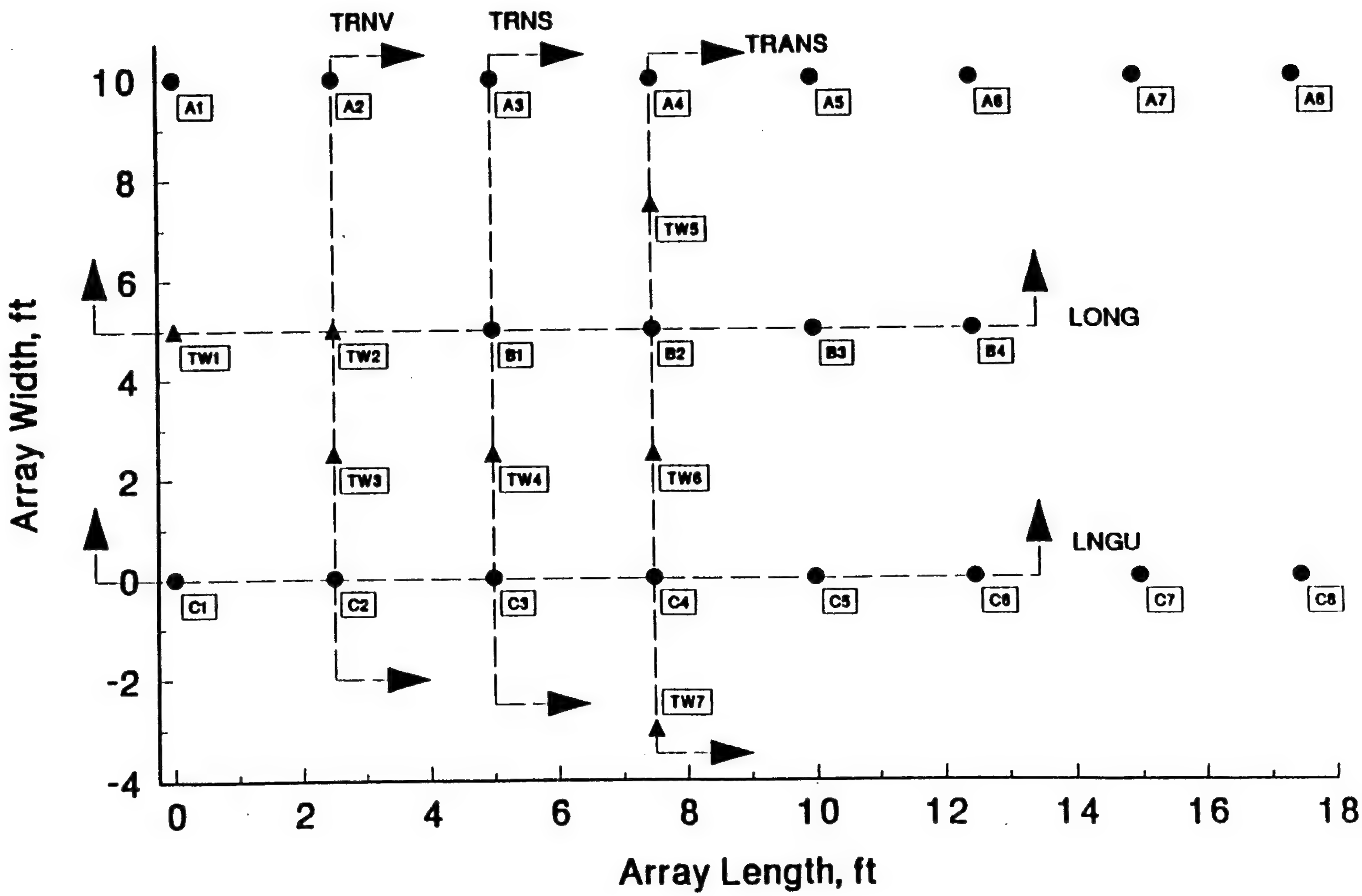


Figure 27. Transverse Temperature Distribution in Plane TRANS
(Depth: 1 ft)

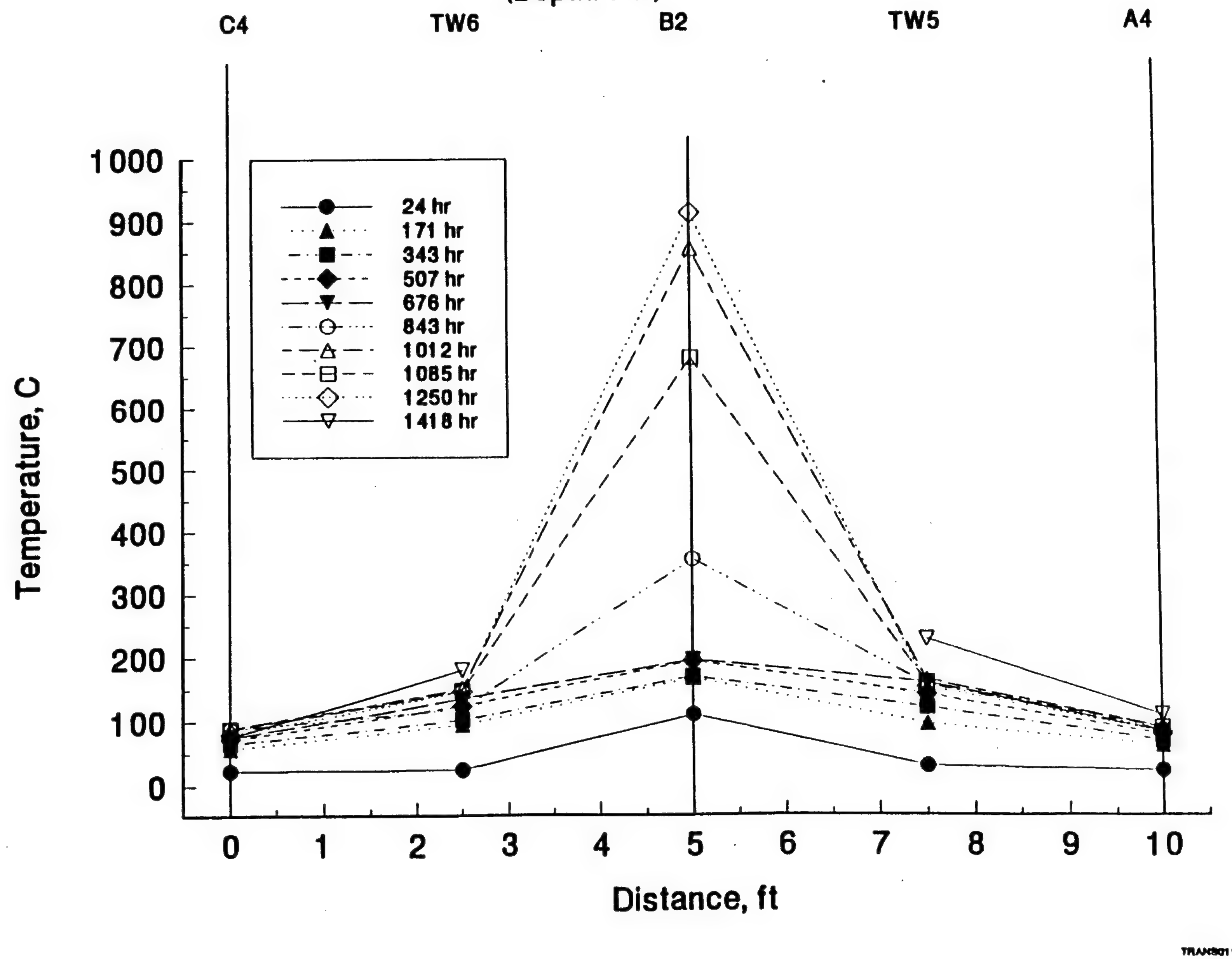


Figure 27 illustrates the spatial temperature distribution in transverse plane labelled TRANS. This is the central plane running perpendicular to the length of the array and it intersects all three rows. Figure 27 shows the temperature profile at a depth of 1 ft. As indicated earlier, ground row temperature at C4 did not exceed 100°C. Temperature at A4 did exceed 100°C towards the end of the experiment. The data shown in this and other spatial distribution figures were selected at approximately one week intervals, after the first day of operation. It should be noted that after 1085 hours, operating difficulties were noted relating to the stability of the electrical match between the load impedance and the impedance of the power source. Temperature at many measurement points decreased after this time, even though attempts were made to continue power input to the soil.

Figure 28 illustrates the transverse temperature distribution at a depth of 10 to 12 ft. B2 was the only measurement point at a depth of 10 ft; all others were at 12 ft. This figure shows the high temperature attained by thermocouple B2B at 1250 hours after start of the demonstration. Figure 29 illustrates the transverse temperature distribution in a depth range of 20 to 24 ft. It should be noted that in this figure, the only measurement point at 20 ft was that in electrode B2, all others were at 24 ft.

B. ANALYSIS OF SOIL FOR TOTAL PETROLEUM HYDROCARBONS

Soil samples obtained from the field by HALLIBURTON NUS were handed over to SAIC, USEPA's contractor for analysis. However, IITRI also performed analysis on the samples using the California DHS method for the analysis of Total Petroleum Hydrocarbons (TPH) expressed as diesel range organics. This was done so that the results may be compared with the results of the Bench scale studies done by IITRI.

The soil samples were shipped to IITRI in coolers after SAIC had finished its analyses of the soil sample. Thus there was a long storage period for these samples, much more than the customary 14 days allowed by many QA/QC procedures. Storage in IITRI was in the original jars which were kept in a refrigerator.

1. Pre-Demonstration Soil Samples

The soil was analyzed by means of methylene chloride extraction followed by extract concentration and analysis of the concentrate by a GC/FID. A solution of diesel in methylene chloride was used to prepare a multi-point calibration curve for the instrument.

Tables 11, 12, and 13 summarize the results of Soil moisture determination, TPH analysis and QA/QC sample analysis,

Figure 28. Transverse Temperature Distribution in Plane TRANS
(Depth: 10-12 ft)

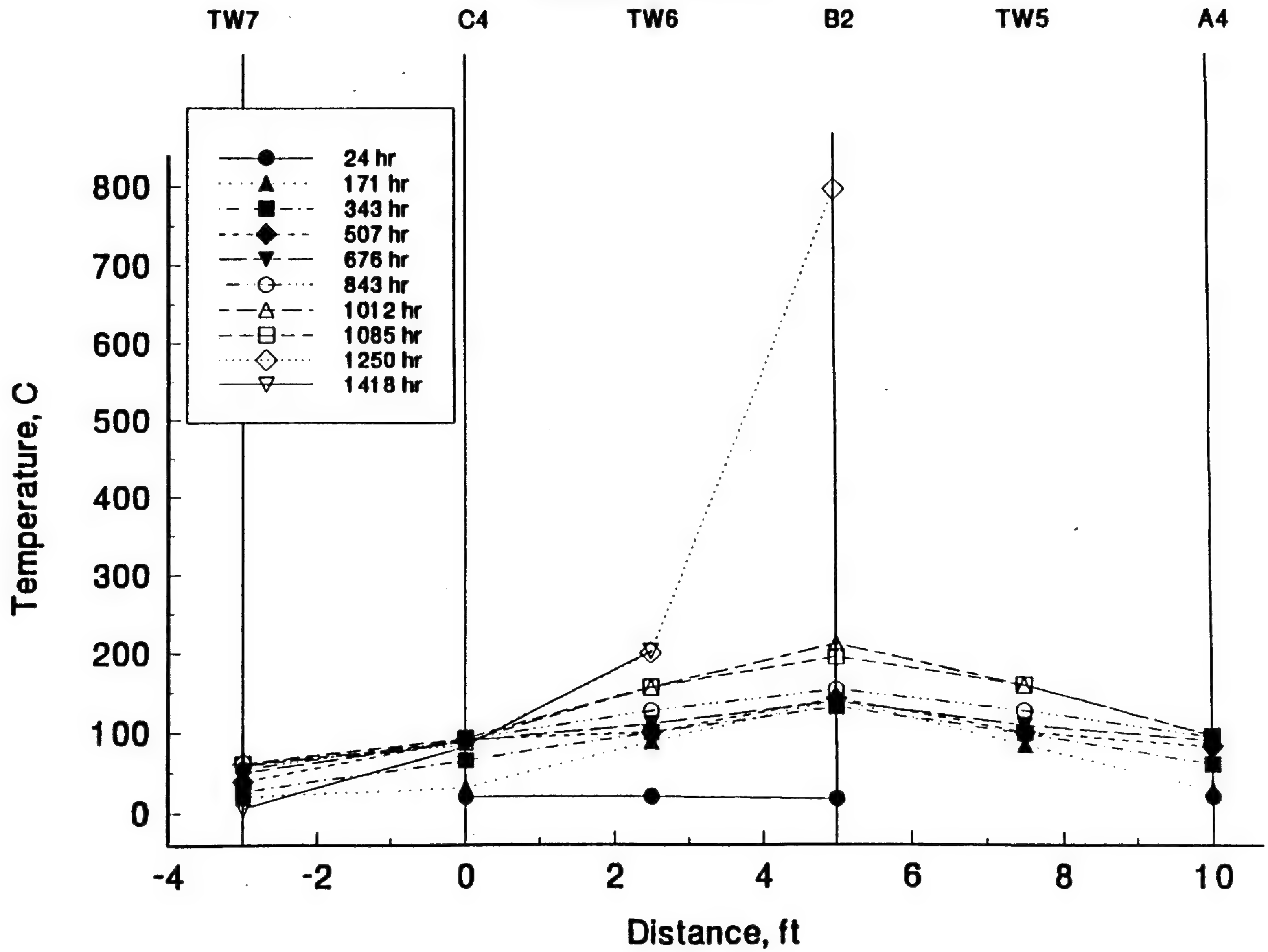


Figure 29. Transverse Temperature Distribution in Plane TRANS

(Depth: 20-24 ft)

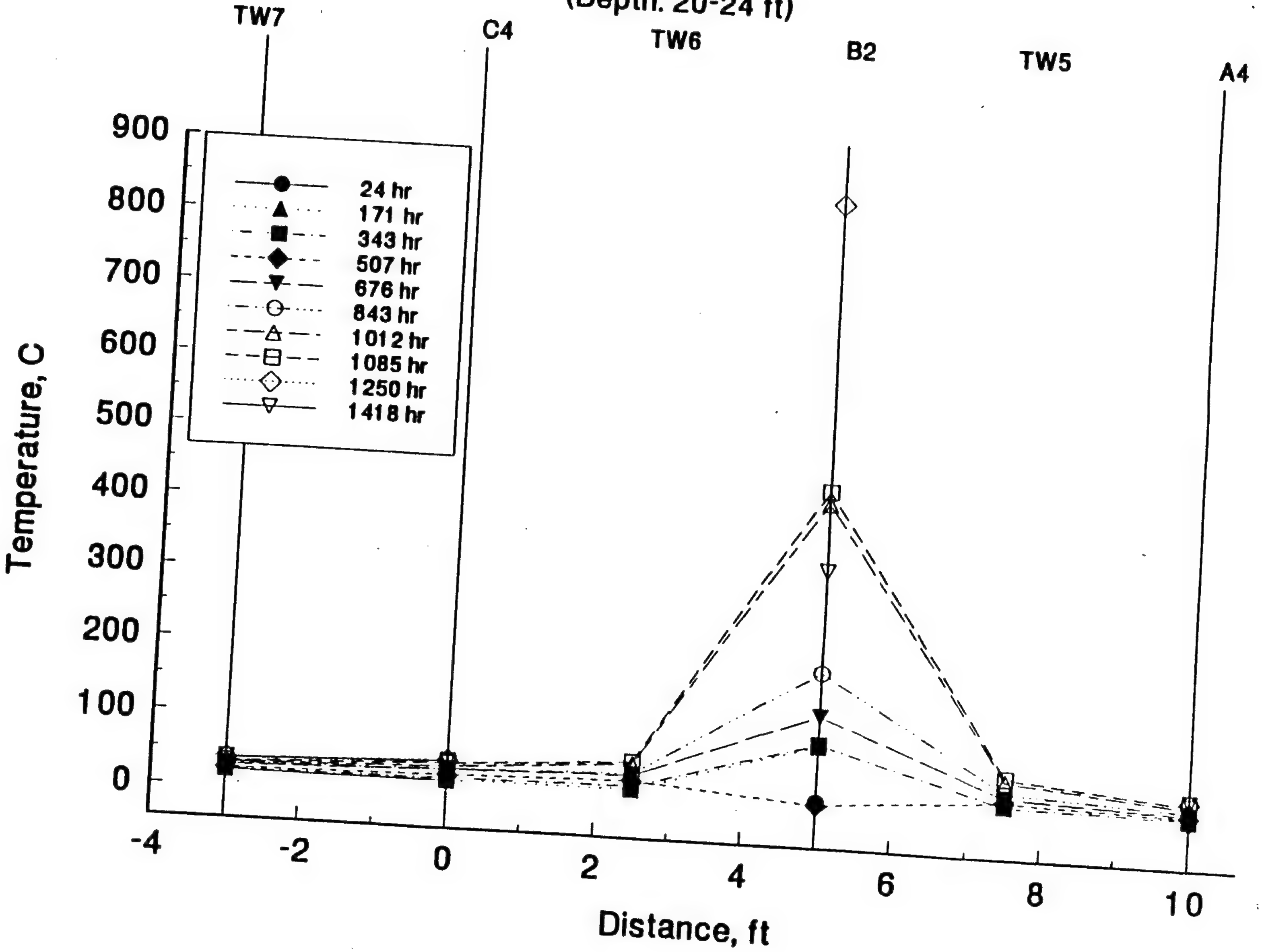


TABLE 11. DETERMINATION OF MOISTURE IN PRE-DEMONSTRATION SOIL SAMPLES

Reference No.	Sample Hole Location	Sample Depth Code	Depth Interval ft	Percent Water	Comment
1	EA01	U0406	4-6	22.0%	
2	EA01	U0406	4-6	20.4%	Duplicate of No. 1 above
3	EA02	U1214	12-14	26.5%	
4	EA03	U0204	2-4	19.9%	
5	EA03	U1618	16-18	15.9%	
6	EA04	U0002	0-2	17.2%	
7	EA04	U2022	20-22	11.0%	
8	EA05	U2224	22-24	10.7%	
9	EA07	U0810	8-10	20.7%	
10	EA07	U1214	12-14	26.4%	
11	EA08	U1416	14-16	23.6%	
12	EA08	U2830	28-30	10.1%	
13	EB01	U0002	0-2	21.1%	
14	EB01	U1214	12-14	27.1%	
15	EB02	U0406	4-6	21.5%	
16	EB02	U0810	8-10	20.3%	
17	EB03	U0204	2-4	16.2%	
18	EB03	U0204	2-4	18.9%	Duplicate of No. 17 above
19	EB03	U1012	10-12	19.3%	
20	EB04	U1416	14-16	21.0%	
21	EB04	U2022	20-22	16.8%	
22	EC02	U0608	6-8	22.9%	
23	EC02	U2022	20-22	8.9%	
24	EC03	U0002	0-2	22.0%	
25	EC03	U1820	18-20	24.2%	
26	EC03	U2224	22-24	9.0%	
27	EC03	U2224	22-24	9.9%	Duplicate of No. 26 above
28	EC05	U1012	10-12	11.0%	
29	EC05	U1012	10-12	11.5%	Duplicate of No. 28 above
30	EC06	U0204	2-4	18.2%	
31	EC06	U1820	18-20	20.6%	
32	EC07	U0406	4-6	16.0%	
33	EC07	U0406	4-6	20.0%	Duplicate of No. 32 above
34	EC08	U0406	4-6	20.0%	
35	EC08	U0406	4-6	16.4%	Duplicate of No. 34 above
36	EC08	U1416	14-16	19.7%	
37	EC08	U2224	22-24	9.8%	
38	TW01	U1416	14-16	22.0%	
39	TW02	U0406	4-6	19.6%	
40	TW02	U1416	14-16	25.7%	
41	TW02	U1416	14-16	23.4%	Duplicate of No. 40 above

TABLE 12. DETERMINATION OF TPH IN PRE-DEMONSTRATION SOIL SAMPLES

Reference No.	Sample Hole Location	Sample Depth Code	Depth Interval ft.	Gas Chromatograph Sample No.	Gas Chromatograph Batch No	TPH Conc. in soil ppm as received	TPH Conc. in soil ppm dry basis	No. of Peaks in Diesel Range	Was Extract Diluted? Yes/ No	Comments
1	EA01	U0406	4-6	MC-23	6	47	61	31	N	
3	EA02	U1214	12-14	MC-28	7	240	326	43	N	
4	EA03	U0204	2-4	MC-35	8	30	37	37	N	
5	EA03	U1618	16-18	MC-4 spike dil	3	6995	8317	58	Y	MC-4 + Spike of 1 ml of 2.06 mg/ml
5	EA03	U1618	16-18	MC-4dil	3	6835	8128	55	Y	
6	EA04	U0002	0-2	MC-27	7	13	15	39	N	
7	EA04	U2022	20-22	MC-20	6	2443	2746	57	N	
7	EA04	U2022	20-22	MC-20RE	6	2426	2727	60	N	MC-20 reinjected
7	EA04	U2022	20-22	MC-38	8	2318	2605	58	N	Duplicate of MC-20
8	EA05	U2224	22-24	MC-7dil	2	2554	2860	55	Y	
9	EA07	U0810	8-10	MC-31	7	78	98	28	N	
10	EA07	U1214	12-14	MC-14	5	21	29	32	N	
10	EA07	U1214	12-14	MC-14RE	6	12	17	39	N	MC-14 reinjected
10	EA07	U1214	12-14	MC-14RE	7	N.D.	N.D.	32	N	MC-14 reinjected
11	EA08	U1416	14-16	MC-34	8	27	35	40	N	
12	EA08	U2830	28-30	MC-29	7	413	460	52	N	
13	EB01	U0002	0-2	MC-37	8	329	417	36	N	
14	EB01	U1214	12-14	MC-8	3	39	53	58	N	
15	EB02	U0406	4-6	MC-6	1	65	82	67	N	
15	EB02	U0406	4-6	MC39	9	171	218	45	N	MC-6+spike: 1.0 ml of 1.92 mg/ml
16	EB02	U0810	8-10	MC-26	7	187	234	25	N	
17	EB03	U0204	2-4	MC-1	3	N.D.	N.D.	26	N	
19	EB03	U1012	10-12	MC-24	6	3027	3751	42	N	
20	EB04	U1416	14-16	MC-15	5	821	1039	54	N	
21	EB04	U2022	20-22	MC-18	5	1049	1260	49	N	
21	EB04	U2022	20-22	MC-18	6	1049	1261	56	N	
21	EB04	U2022	20-22	MC-40	8	1490	1791	60	N	MC-18 + spike: 5.0 ml of 1.92 mg/ml

N.D.: None Detected
Shaded Results: In these the TPH area response was less than or equal to Average method blank area + three times standard deviation of the blanks

RE: Extract reinjected, Duplicate: duplicate extraction/injection; dil: extract was diluted

TABLE 12. DETERMINATION OF TPH IN PRE-DEMONSTRATION SOIL SAMPLES

Reference No.	Sample Hole Location	Sample Depth Code	Depth Interval ft.	Gas Chromatograph Sample No.	Gas Chromatograph Batch No	TPH Conc. in soil ppm as received	TPH Conc. in soil ppm dry basis	No. of Peaks in Diesel Range	Was Extract Diluted? Yes/No	Comments
22	EC02	U0608	6-8	MC-2	1	351	455	64	N	
22	EC02	U0608	6-8	MC-2RE	2	341	443	61	N	MC-2 reinjected
23	EC02	U2022	20-22	MC-32	8	2597	2852	58	N	
24	EC03	U0002	0-2	MC-12	4	34	44	39	N	
25	EC03	U1820	18-20	MC-21	6	5499	7257	50	N	
25	EC03	U1820	18-20	MC-21 DIL	7	9239	12194	55	Y	
26	EC03	U2224	22-24	MC-5	2	4287	4710	59	Y	
26	EC03	U2224	22-24	MC-5 DUP.	2	3964	4400	58	Y	MC-5 duplicated
26	EC03	U2224	22-24	MC-5 DUP.	2	4003	4443	58	Y	Reinjection of MC-5 duplicate
28	EC05	U1012	10-12	MC-3	3	865	972	50	N	
28	EC05	U1012	10-12	MC-3D2	3	996	1119	61	Y	MC-3 diluted, X 22.2
28	EC05	U1012	10-12	MC-3 dil	3	862	969	62	Y	MC-3 diluted, X 7.41
29	EC05	U1012	10-12	MC-25	6	463	523	38	N	MC-3 duplicate
30	EC06	U0204	2-4	MC-30	7	68	83	36	N	
31	EC06	U1820	18-20	MC-33	8	3126	3938	55	N	
31	EC06	U1820	18-20	MC-33RE	9	3148	3965	57	N	MC-33 reinjected
31	EC06	U1820	18-20	MC-33dil	10	3228	4066	54	Y	MC-33 diluted
32	EC07	U0406	4-6	MC-16	5	26	31	35	N	
34	EC08	U0406	4-6	MC-19	5	20	25	31	N	
36	EC08	U1416	14-16	MC-9	3	N.D.	N.D.	41	N	
36	EC08	U1416	14-16	MC-17	6	52	65	44	N	Duplicate of MC-9
37	EC08	U2224	22-24	MC-10	4	1945	2156	52	N	
38	TW01	U1416	14-16	MC-22	6	504	646	58	N	
39	TW02	U0406	4-6	MC-11	4	31	39	35	N	
40	TW02	U1416	14-16	MC-36	8	426	573	49	N	

N.D.: None Detected

Shaded Results: In these the TPH area response was less than or equal to Average method blank area + three times standard deviation of the blanks

RE: Extract reinjected, Duplicate: duplicate extraction/injection; dil: extract was diluted

TABLE 13. DETERMINATION OF TPH IN PRE–DEMONSTRATION SOIL SAMPLES QA/QC SAMPLES

Gas Chromatograph Sample No.	Batch No	TPH Conc. in sample mg/ml As Analyzed	TPH Conc. in sample mg/ml Actual	Error %	Comments
KQA–1	3	4.33	4.12	5.1%	QA/QC Control Sample for Checking of GC
KQA–2	3	2.18	2.13	2.6%	QA/QC Control Sample for Checking of GC
MCMB–2	3	N.D.	0		Method Blank (TPH Area: 14,151)
MC–13	4	0.04	0		Method Blank (TPH Area: 18,033)
KQA–3	4	5.78	5.52	4.8%	QA/QC Control Sample for Checking of GC
KQA–4	4	2.95	2.76	7.0%	QA/QC Control Sample for Checking of GC
KQA–4	5	2.84	2.76	2.9%	QA/QC Control Sample for Checking of GC
KQA–3	6	5.60	5.52	1.4%	QA/QC Control Sample for Checking of GC
KQA–4	6	2.81	2.76	1.9%	QA/QC Control Sample for Checking of GC
KQA–F	7	1.91	1.93	−1.0%	QA/QC Control Sample for Checking of GC
KQA–3	7	5.78	5.52	4.7%	QA/QC Control Sample for Checking of GC
KQA–F	9	1.94	1.93	0.3%	QA/QC Control Sample for Checking of GC
KQA–3	9	5.62	5.52	1.9%	QA/QC Control Sample for Checking of GC
MC–43	10	0.33		R	Method Blank with spike: 1 ml. of 7.638 mg/ml
MC–41	10	0.04	0		Method Blank, no spike (TPH Area: 20,020)
MC–42	10	0.25		R	Method Blank with spike: 1 ml. of 1.92 mg/ml

N.D.: None Detected

R: Spike recovery calculation made separately in Table 14

respectively. Thirty four different samples were analyzed. The results show that the soil concentration varies from less than 35 ppm to 9200 ppm (as received). On a dry basis the concentration ranges from less than 44 to 12,200 ppm. In a number of samples it was observed that there were compounds present, outside the diesel window, towards the higher boiling end. These have not been included in the reported results. There were eight samples in which the concentration (as received) was in the range of 12 to 34 ppm. In these eight samples, the TPH area count is within 3 standard deviations of the area count of the method blanks.

Table 14 is a summary of the spiked sample analyses. Two types of spiked samples were analyzed. First, the soil as received from the field was spiked with a known amount of TPH. Then the spiked soil was extracted and the extract analyzed on the GC/FID. The results were compared (through a mass balance on TPH) with the results of the unspiked field soil to determine the percent recovery. The percent recovery ranged between 200 and 320 percent. It should be noted that the TPH concentration reported in Table 12 has not been corrected by the recovery efficiency.

In the second type of spiking experiment, a method blank was spiked with a known amount of TPH (Table 14). The recovery was calculated by a mass balance on TPH. The mass balance was done by a comparison of TPH mass in unspiked method blank versus the spiked method blank. The recovery of TPH from spiking of the method blanks was in the range of 103 to 130 percent.

Table 15 is a summary of sample duplicates. Four samples were extracted and analyzed in duplicate. The relative percentage difference (RPD) ranges from 2.5 to 100 percent. The low concentration sample gave the 100 percent RPD. In four cases, the prepared extract was injected twice into the GC/FID to test the reproducibility of the instrument. The RPD was in the range of 0.4 to 1.5 percent. In one case, a low concentration (less than 21 ppm) sample was injected three times which yielded a relative standard deviation of 96 percent.

2. Post-Demonstration Soil Samples

The post demonstration soil samples were analyzed in a similar manner as the pre-demonstration soil samples. Even these samples had a long storage period as mentioned earlier.

Twenty one post-demonstration soil samples were analyzed by the California DHS method. The result of these analyses are presented in Table 16. The concentrations of soil moisture and TPH are presented in the table.

TABLE 14. SPIKE RECOVERY

RECOVERY OF TPH SPIKES FROM SOIL

Ref. No.	Sample Nos.	TPH Conc. in Soil as Received ppm	Amount Spiked Equivalent, ppm	Total TPH Conc. in Spiked Soil ppm	Spike Recovery %
5	MC-4 MC-4 spike,dil	6835	50	6995	320
15	MC-6 MC-39	65	46.2	171	229
21	MC-18 MC-40	1049	218	1490	202

RECOVERY OF TPH SPIKE FROM METHOD BLANKS

	Total TPH mg	Recovery %
Unspiked Method Blank:	0.4	---
Method Blank + 1.92 mg spike	2.5	130
Method Blank + 7.64 mg spike	8.25	103

TABLE 15. RESULTS OF DUPLICATE ANALYSIS

RESULTS OF DUPLICATE EXTRACTIONS/GC ANALYSIS

Sample No.	TPH Conc. as received ppm	Sample No.	TPH Conc. as received ppm	Sample No.	TPH Conc. as received ppm	Sample No.	TPH Conc. as received ppm
MC-5	4287	MC-25	463	MC-20	2435	MC-9	0
MC-5dup	3984	MC-3	906	MC-38	2318	MC-17	52
Average	4136		686		2377		26
R.P.D	3.7%		32.0%		2.5%		100.0%

RESULTS OF DUPLICATE GC INJECTIONS

Sample No.	TPH Conc. as received ppm	Sample No.	TPH Conc. as received ppm	Sample No.	TPH Conc. as received ppm	Sample No.	TPH Conc. as received ppm	Sample No.	TPH Conc. as received ppm
MC-20	2443	MC-2	351	MC-5DUP	3964	MC-33	3126	MC-14	21
MC-20RE	2426	MC-2RE	341	MC-5DUPRE	4003	MC-33RE	3148	MC-14RE	12
								MC-14RE	0
Average	2434.5		346		3983.5		3137		11
R.P.D	0.4%		1.5%		0.5%		0.4%		

TABLE 16. POST DEMONSTRATION SOIL ANALYSIS FOR TPH BY CALIFORNIA METHOD AND MOISTURE BY WEIGHT LOSS IN OVEN
(Preliminary Results Subject to Review and Correction)

Sample Hole Location	Sample Depth Code	Depth Interval ft	Percent Water	Gas Chromatograp Sample No.	Gas Chromatograp File No.	Date Injected	Regression Reference	TPH Conc. In extract mg/ml	TPH Conc. In soil, ppm as received	TPH Conc. In soil, ppm dry basis	No. of Peaks In Diesel Range	Was Extract Diluted? Yes/ No	Comments
EA01A	U0608	6-8	5.0%	F120	Final20	05/06/94	NSMSTR01	0.91	128	134	49	N	
EA02A	U1416	14-16	18.7%	F116	Final21	05/06/94	NSMSTR01	1.99	360	443	50	N	
EA02A	U1416	14-16	23.4%	F138	Final143	05/20/94	NSMSTR03	50.19	6766	8838	29	N	
EA02A	U1416	14-16	23.4%	F138DIL	Final182	05/25/94	NSCAL09	51.08	6885	8993	35	Y	
EA03A	U1820	18-20	6.1%	F86	Final19	05/06/94	NSMSTR01	15.45	2497	2660	40	N	
EA03A	U1820	18-20	6.1%	F86DII	Final27	05/09/94	NSCAL04	10.03	1622	1727	32	Y	
EA03A	U1820	18-20	6.1%	F86DII	Final156	05/21/94	NSMSTR03	15.48	2502	2665	46	Y	
EA04A	U0002	0-2	6.5%	F94	Final40	05/10/94	NSCAL05	0.07	10	11	48	N	
EA04A	U0002	0-2	6.5%	F94DUP	Final195	05/27/94	NSCAL10	0.09	14	15	39	N	
EA04A	U2022	20-22	0.4%	F159	Final23	05/06/94	NSMSTR01	5.31	504	507	37	N	
EA04A	U2022	20-22	0.4%	F159S	Final22	05/06/94	NSMSTR01	9.79	1213	1216	36	N	F159 spiked with 17.1 mg of TPH
EA04A	U2022	20-22	0.4%	F159SDI	Final155	05/21/94	NSMSTR03	10.01	1241	1246	39	Y	F159S Diluted
EA05A	U2223	22-23	1.9%	F121	Final42	05/10/94	NSCAL05	14.76	1753	1786	34	N	
EA05A	U2223	22-23	1.9%	F121DII	Final51	05/11/94	NSCAL06	5.56	660	672	40	Y	
EA05A	U2223	22-23	1.9%	F121DII[	Final157	05/21/94	NSMSTR03	9.79	1162	1184	37	Y	
EA06A	U1820	18-20	3.0%	F175	Final43	05/10/94	NSCAL05	2.28	279	288	44	N	
EA07A	U0810	8-10	0.3%	F177	Final41	05/10/94	NSCAL05	0.20	26	26	42	N	
EA07A	U1214	12-14	3.0%	F176	Final50	05/11/94	NSCAL06	0.82	123	127	52	N	
EA08A	U1416	14-16	8.7%	F155	Final39	05/10/94	NSCAL05	2.93	440	482	38	N	
EB01A	U0002	0-2	0.5%	F13	Final52	05/11/94	NSCAL06	0.04	5	5	42	N	
EB01A	U0002	0-2	0.5%	F13Rex	Final145	05/20/94	NSMSTR03	0.36	43	43	47	N	
EB01A	U1618	16-18	0.3%	F107	Final53	05/11/94	NSCAL06	0.24	29	29	36	N	
EB01A	U1618	16-18	0.3%	F107Rex	Final163	05/22/94	NSMSTR03	0.41	71	71	38	N	
EB02A	U0406	4-6	0.2%	F12	Final58	05/11/94	NSCAL06	0.05	7	7	49	N	
EB03A	U0204	2-4	0.4%	F39	Final61	05/11/94	NSCAL06	0.13	16	16	39	N	
EB03A	U0204	2-4	0.4%	F39Rex	Final144	05/20/94	NSMSTR03	0.44	61	61	44	N	
EB03A	U0204	2-4	0.4%	F131-1	Final148	05/20/94	NSMSTR03	0.40	48	48	40	N	
EB03A	U0204	2-4	0.4%	F131-2!	Final149	05/21/94	NSMSTR03	3.01	348	350	43	N	F131-1 spiked with 31 mg TPH
EB03A	U1012	10-12	2.8%	F73	Final56	05/11/94	NSCAL06	0.03	4	4	44	N	
EB04A	U1618	14-16	3.9%	F34	Final75	05/12/94	NSCAL07	0.73	107	112	35	N	
EB04A	U2022	20-22	7.9%	F6	Final60	05/11/94	NSCAL06	2.09	273	297	38	N	
EB04A	U2022	20-22	7.9%	F6Dup	Final201	05/27/94	NSCAL10	2.21	290	315	34	N	

Rex: Duplicate Extraction of soil, Dup: duplicate injection; Dil: extract diluted

3. Removal of TPH

A comparison of the post test and pretest concentration of DRO was done. This is summarized in the attached Table 17. Figure 19 (Page 56) is a plan view of the electrode array which helps to elucidate the various comparisons made in Table 17. Table 17 summarizes the average concentration of DRO TPH as a function of heated soil zones. There are four zones based upon which the comparison was made.

The first zone is the entire heated volume to a depth of less than or equal to 24 ft; in this zone the average concentration in the defined volume was calculated by considering all valid analytical results.

The second zone is defined by the area enclosed by the four corner electrodes A1, C1, C8, A8 and a depth less than or equal to 20 ft. Only valid analytical results for samples which were obtained from this volume were averaged.

The third zone is defined by the area enclosed by the central electrodes A3, C3, C6, A6 and a depth less than or equal to 24 ft.

The fourth zone is defined by the area bounded by the central electrodes A3, C3, C6, A6 and a depth less than or equal to 20 ft. As Table 17 illustrates, the highest removal was obtained in the central zone to a depth of 24 ft or less. In this zone the removal of DRO TPH was 67 to 69 percent. As the volume is enlarged to include the entire surface area (defined by A1,C1,C8,A8) the removal drops to 23 to 29 percent to a depth of 24 ft or less. A review of the soil samples taken from the lateral Volume II indicates that in this region the concentration of the soil may have increased. A similar increase may have occurred in the corresponding volume at the opposite end of the array. This cannot be definitely concluded due to lack of paired before and after samples of soil from this region of the array.

The above data are presented in terms of two depth ranges because the central row of electrodes, the excitor row had a depth of 20 ft and the two outer rows had a depth of 29 ft. The central row was originally designed for a depth of 24 ft. Its depth was decreased in the field because a shallow water table was encountered in the depth interval of 19 to 24 ft. A corresponding depth reduction of the two outer rows was not done due to time and logistics constraints. The heated depth extends below the bottom of the excitor electrodes. This heating is caused by electric fields fringing below the central row of electrodes. It is estimated that fringing fields could extend the heating effect by an additional depth equal to 50 to 60 percent of row separation (that is 2.5 to 3 ft more).

TABLE 17. SUMMARY OF TPH ANALYSIS DONE AT IITRI, PPM

	Pre-Demonstration				Post-Demonstration			
Volume	n	$\bar{x}$	s	R.S.D.	n	$\bar{x}$	s	R.S.D.
Total, for all depths ≤24′	33	1518	2636	174	33	1077	2131	198
For volume defined by (A1, Cl, C8, A8) Depth ≤20′	26	1280	2866	224	28	984	2261	230
For volume defined by (A1,C1,C2,A2) Depth ≤24′ (Volume II)	7	706	975	138	8	2405	3495	145
For volume defined by (A1,C1,C2,A2) Depth ≤20′	6	348	257	74	7	2348	3771	161
For volume defined by (A3, C3, C6, A6) depths ≤24′	18	2347	3300	141	17	730	1467	201
For volume defined by (A3, C3, C6, A6) depths ≤20′	14	2208	3707	168	14	717	1610	225

The data were presented in terms of two areal zones because the maximum temperature rise was confined to the central zone as defined by electrodes A3, C3, C6, A6.

A graphical comparison of the soil concentrations before and after the demonstration experiment was made. The data for samples obtained from ground row A is shown in Figure 30. A two-dimensional pattern is revealed regarding the distribution of sampling points. This pattern may have biased the results for the following reasons:

- It is known that the concentration of TPH increased with depth,and that it was higher in the depth interval of 12 to 25 ft. As the figure shows, deep samples were taken below the 20 ft zone (below the bottoms of the excitor electrodes).

- There were no samples taken in the middle of the heated zone, that is, the zone defined by Electrodes A3 to A6 and depth interval of 2 to 20 ft. This was the area of highest temperature increase in Ground Row A.

- Samples taken at depth may be confounded by the presence of the water table for depths larger than 24 ft.

Based on the comparison of the post test and pre-test average concentration, there was no removal of TPH in the vertical plane defined by ground row A. The average pre-test concentration in this plane was 1340 ppm and the post test average was 1478 ppm.

Figure 31 illustrates the distribution of contaminant concentration in the vertical plane represented by the excitor row electrodes. This plane includes the two thermowells TW1 and TW2. The location of sampling points are such that no obvious pattern can be discerned from Figure 31, which is the desired random distribution of the sampling points. The average pre-test concentration of TPH in this plane was 809 ppm. The average post test concentration was 710 ppm if all the data are included. There is one post test sample which seems to increase the post test average from 127 ppm to 710 ppm. This is the sample in TW1 from the depth interval of 14 to 16 ft. The analyzed concentration is in excess of three standard deviations of the average of the remaining samples.

Figure 32 illustrates the concentration profile for TPH in the vertical plane represented by ground row C. The distribution of sampling point locations does not reveal any pattern, which was the desired outcome. The average concentration of all the pre-test samples was 2271 ppm. The average of all the post-test samples was 1079 ppm, which represents a concentration decrease of

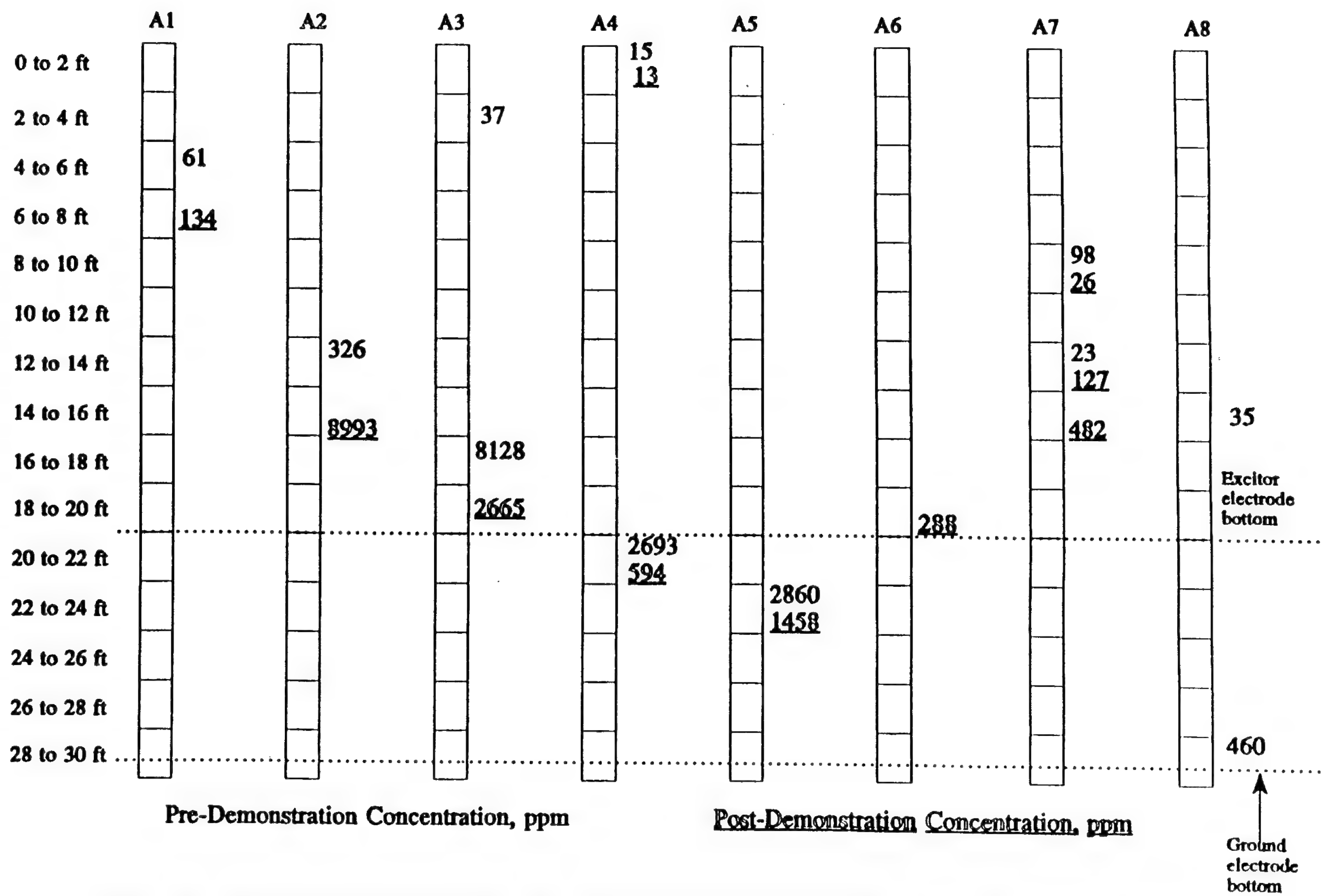


Figure 30. Pre and Post Demonstration TPH Concentration in Electrode Row A as a Function of Depth

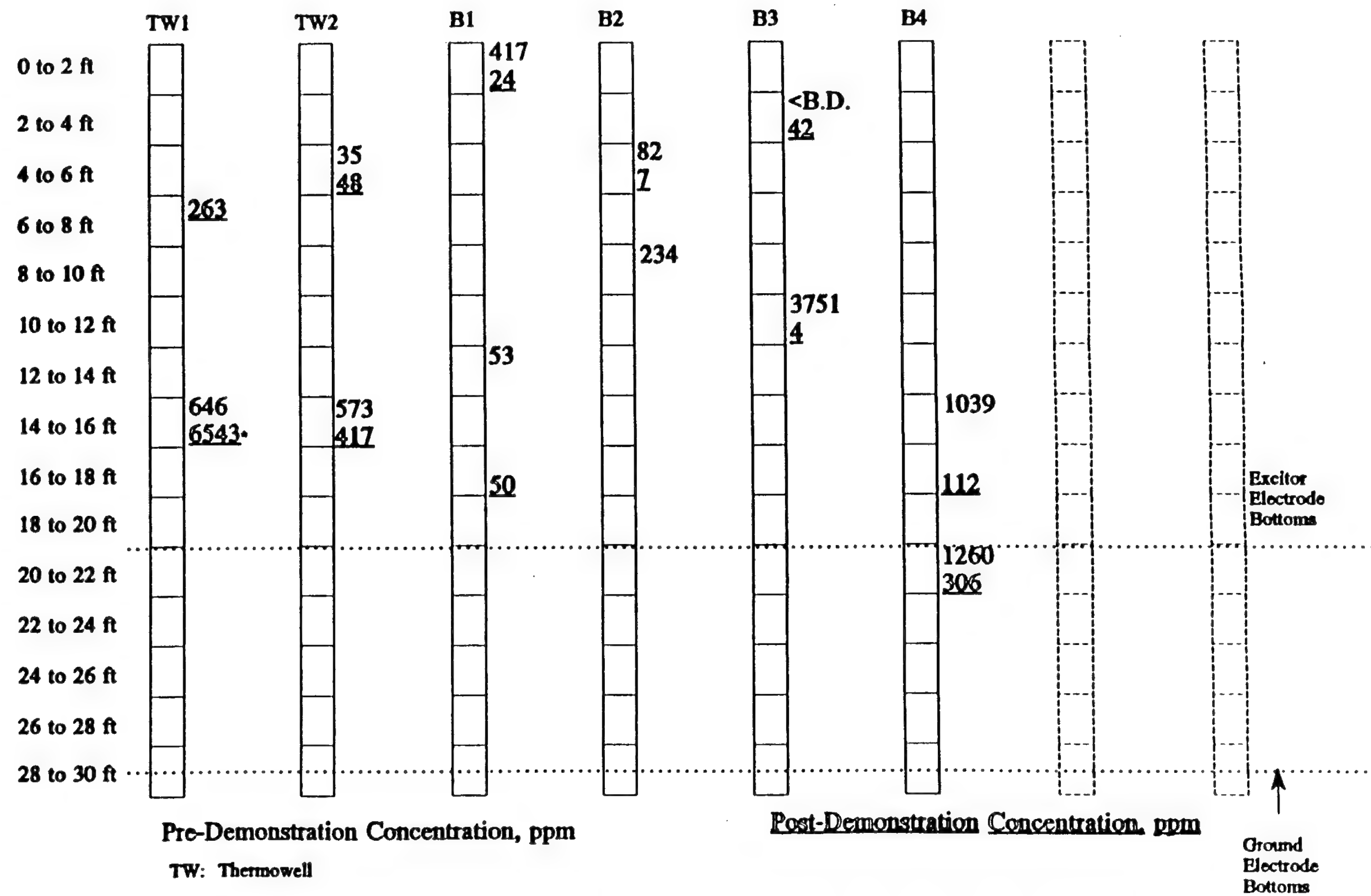


Figure 31. Pre- and Post-Demonstration TPH Concentration in Electrode Row B as a Function of Depth

* Outside 3 standard deviations of the average of all the other post-test samples in this plane

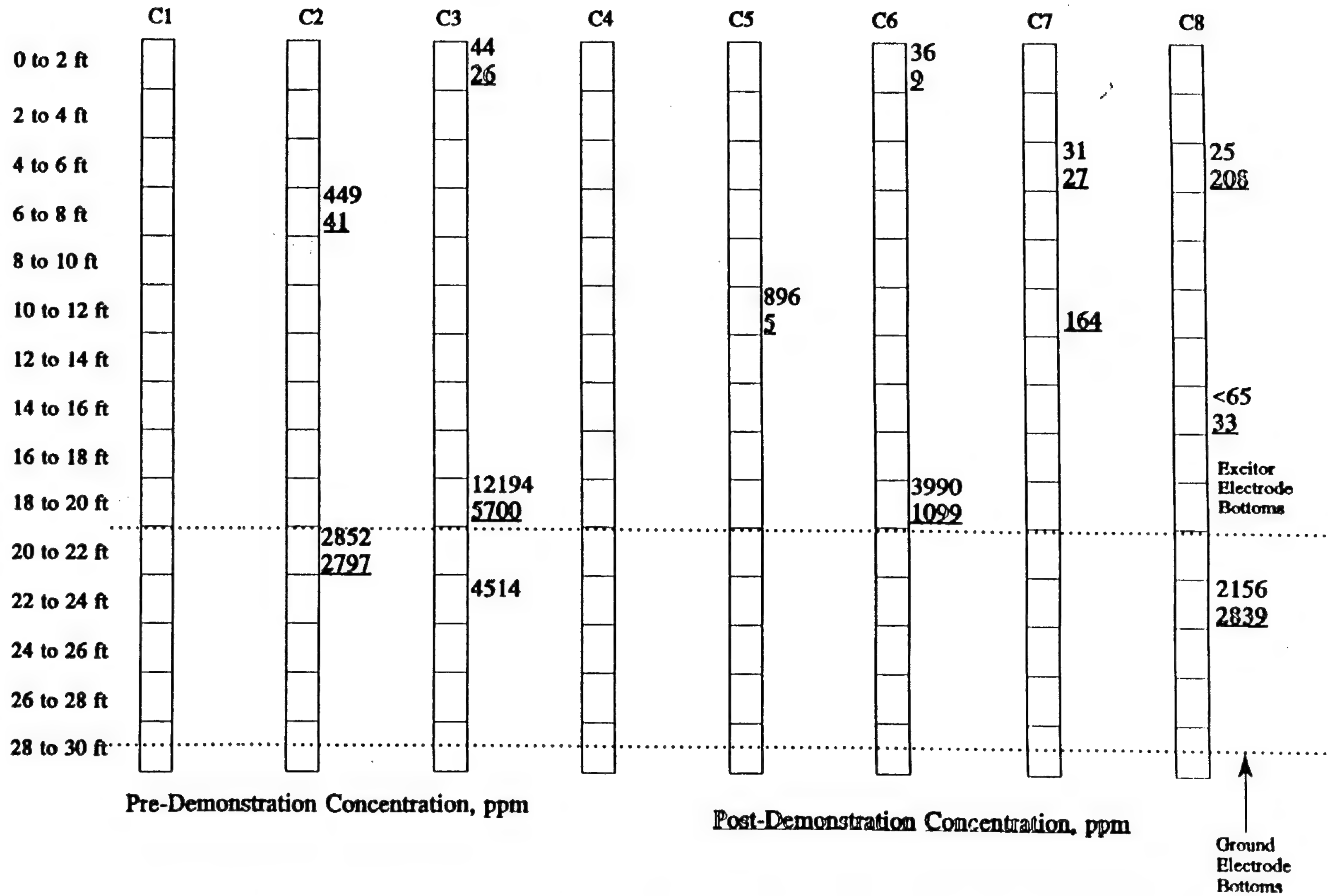


Figure 32. Pre- and Post-Demonstration TPH Concentration in Electrode Row C as a Function of Depth

approximately 53 percent. If the samples taken below the depth of 20 ft are removed then concentration decrease is approximately 63 percent.

C. TRACER INJECTION EXPERIMENT

Towards the end of the heating portion of the demonstration a tracer experiment was done to show that soil fluids were moving into the heated zone. The tracer experiment was performed on May 30, 1993 between 9:00 and 15:30 hrs. The results of the tracer experiment are summarized here along with a description of the procedures.

Halon 2402, dibromotetrafluoroethane, was used as a chemical tracer. The tracer was injected outside the heated array, in cool soil at a depth of 7 feet. The injection point was located on a center line approximately 9 ft from the western edge of the array. The distance from the center of the array was approximately 14 ft. The soil temperature at the injection point was 32.3°C. The tracer was injected into a 0.25-in. O.D. copper tubing which was placed in a bore hole at the time of system installation. After introduction into the copper tube the tube opening was closed to prevent the escape of the tracer. The raw gases leaving the heated zone were sampled and analyzed for the presence of Halon 2402. A gas chromatograph equipped with an electron capture detector was used for the analysis. The purpose of the tracer experiment was to prove that the tracer moves into the heated zone. Thus only qualitative analysis was performed.

1. Materials and Equipment

Halon 2402 is a liquid at ambient temperature, boiling at 47.3°C. The liquid density is 135 lb/cu. ft. at 70° F. The vapor specific gravity is 8.97 (Air =1).

A Packard gas chromatograph, Model 427 equipped with a Nickel -63 electron capture detector was used for the analysis of Halon 2402. A stainless steel column, 1/8 in O.D. packed with 80/100 mesh Porapak Q was used for separation. The column was purchased from Altech. The GC operating conditions were: Injector temperature 220°C; oven temperature 220°C; detector temperature 230°C; carrier gas zero grade nitrogen supplied at a head pressure of 60 psig which gives a flow rate of approximately 20 ml/min.

Gas tight syringes were used to inject the gas sample into the GC. The retention time of Halon 2402 was in the range of 1.6 to 1.65 minutes. It was found by injecting the gas from the head space of a vial containing pure Halon 2402.

After the injection of the halon tracer into the soil the raw gases leaving the soil were sampled and analyzed for the presence of Halon 2402. The sampling system is illustrated in Figure 1 and the procedure is described below.

2. Procedure for Performing the Tracer Experiment

The overall procedure for performing the tracer experiment has four part:

- Set up of GC and confirmation of Halon 2402 peak elution time.
- Set up of a raw gas sampling train
- Collection of preliminary and background data and information prior to tracer injection
- Collection of gas samples and their analysis after tracer injection

Set Up of GC and Determination of Elution Time

The ECD GC was set up and several injections were made to determine the elution time of the Halon tracer. The base line was verified to be clean after the tracer peak had eluted. When injecting room air the chromatogram showed a response for air and then had a clean baseline. The sensitivity of the detector should was set in the medium range, about 3 to 4. The retention time of Halon 2402 was in the range of 1.6 to 1.65 minutes.

Gas Sampling Equipment and Procedure

Figure 33 illustrates the method of setting up the gas sampling train. The gas sample point for the tracer study was the same point on the ejector system where Halliburton personnel had been taking samples for volatile and semi-volatile analysis. But existing tygon tubing was replaced with 0.25 in. O.D. teflon tubing. The sample was conveyed to a glass flask in which any water droplets in the line were separated. The outlet port of the flask was connected to a diaphragm pump. A Thomas pump was used. This pump has a teflon-lined rubber diaphragm. This is a positive displacement pump and will generate high pressure if the outlet is blocked or restricted.

The outlet of the pump was connected to valve V1. The line leaving V1 was connected to a Tee. Valve V2 was connected to the branch leg of the Tee. The run-leg of the Tee was connected to teflon tubing which was connected to the glass gas sampling bottle by means of a short length of tygon tubing.

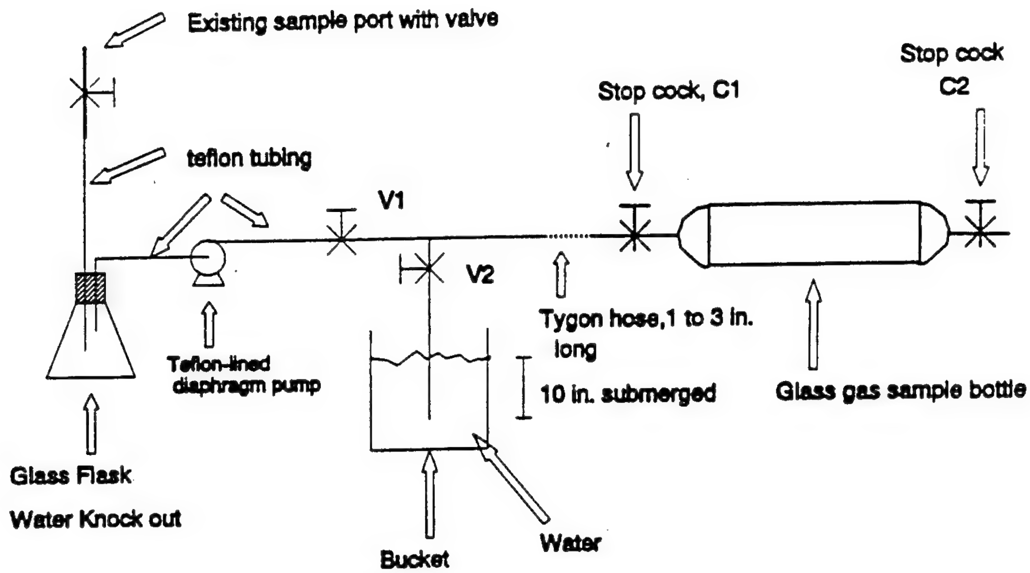


Figure 33. Gas Sampling Scheme for the Tracer Experiment

The line leaving from the branch leg of the Tee was connected to Valve V2. The line leaving valve V2 was submerged in 10 in. of water. This line was made from tygon hose. The purpose of this line was to allow the filling of the gas sample bottle under pressure of 10 in. of water.

The gas sample train was started and used in the following manner:

First the pressure was set as follows:

- With valve V1 open, valve V2 was cracked open. Stop cock C1 was closed. Pump was turned on. Valve V2 was adjusted so that the air just bubbled out of the submerged tubing.

Gas was sampled as follows:

- With the pump running as above, stop cocks C1 and C2 were turned on.

- Gas was flushed through the gas sample bottle for about 3 min. Then stop cock C2 was closed followed by stop cock C1. Pump was switched off. The sample bottle was labelled with date and time.

Sampling the Gas Bottle for GC Injection

A rubber septa was attached on one outlet end of the filled gas sample bottle. The stop cock at the same end was opened. The gas was sampled with the syringe needle inserted through the septa. After removing sample the stop cock was closed.

Collection of background information prior to tracer injection:

- Insert a thermocouple into the tracer injection well (0.25 in tubing) and measure the temperature and the depth of the hole. **CAUTION: RF power must be switched off while inserting and using the thermocouple.**

- Before injecting the trace the following operating conditions were recorded:

  * All the RF power input parameters
  * All the data from the vapor collection system.

Injection of tracer

A 5 ml. syringe was filled with the liquid tracer and it was injected into the copper tracer injection tubing inserted in the ground. The time and date were recorded. The copper injection tubing was capped.

Immediately after the injection of the tracer a gas sample was taken. New gas samples were taken after every 15 minutes until 120 minutes had elapsed.

Prior to reuse, the gas sample bottles were thoroughly flushed out and cleaned. The cleanliness of the sample bottle was verified by analyzing a sample taken from the bottle after it had been flushed.

3. Trace Injection Results

The results of the gas samples analyzed for the presence of the tracer gas in the raw gas stream collected from the heated soil zone are presented in Table 18.

TABLE 18. RESULTS OF TRACER INJECTION EXPERIMENT

Tracer Injection Time	Sample No.	G.C. Run No.	Sampling Time Start	Sampling Time Finish	Elapsed Time min.	Sample Injection Volume ml.	Area Response	Normalized Area Response per ml. sample
5/30/93	*	17				0.05	1,442,000	28,840,000
9:04	3	18	09:07	09:10	4.5	0.05	1,128,900	22,578,000
	4	19	09:32	09:35	29.5	0.1	797,460	7,974,600
	5	20	09:59	10:02	56.5	0.1	567,310	5,673,100
	6	21	10:23	10:26	80.5	0.1	707,970	7,079,700
	7	22		Estimated	110	0.1	1,575,500	15,755,000
	8	24	11:32	11:35	149.5	0.1	880,460	8,804,600
	9	25	12:02	12:05	179.5	0.1	799,350	7,993,500
	10	26	12:32	12:35	209.5	0.1	1,359,100	13,591,000
5/30/93	11	27	13:11	13:14	12.5	0.1	0	0
13:00	11	28	13:11	13:14	12.5	0.1	1,356,300	13,563,000
	12	29	13:25	13:28	26.5	0.2	1,276,800	6,384,000
	13	30	13:50	13:53	51.5	0.2	0	0
	14	31	14:12	14:15	73.5	0.2	626,480	3,132,400
	15	32	14:42	14:45	103.5	0.2	110,760,000	553,800,000
	15	33	14:42	14:45	103.5	0.2	159,270,000	796,350,000
	16	37	15:06	15:09	127.5	0.2	8,217,600	41,088,000

* Blank sample comprising of the atmospheric air at the site

Halon 2402 was first injected into the injection well at 09:00 hrs on May 30, 1993. Approximately 5 ml. of the tracer was injected. The first sample of raw gas from the vapor collection system was obtained between 09:07 and 09:10 hrs. Additional samples were obtained every 15 to 20 minutes. A sample of the gas was injected into the GC/ECD and the peak elution time and peak area were noted. The data are summarized in Table 18. As shown by the results of samples 3 through 10 the presence of tracer in the raw gas stream could not be conclusively proven although it appears that sample 7 had increased levels of the tracer.

One reason that the tracer response was so low is that we had injected insufficient amount of the tracer and it was getting diluted by the air and gases flowing into the vapor collection system. Thus another larger injection of the tracer was made later the same day at 13:00 hrs four hours after the first injection. Twenty five ml. of the liquid tracer was injected. A large increase in the GC response was observed for sample number 15 which was taken approximately 104 minutes after the second tracer injection.

These results show that the liquid tracer injected outside of the heated zone migrated inside and was collected by the vapor collection system. Because of the way the experiment was done, it is not possible to rule out the fact that the observed increase of the tracer concentration in the gas samples may have been due to the first tracer injection and not the second. If this is indeed the case, then the tracer could have taken as long as 5 hr and 40 minutes to be collected by the vapor collection system.

D. ELECTRICAL DATA

1. RF System Performance

The operational performance of the RF heating system used for the Kelly AFB demonstration test was evaluated by monitoring the RF power delivered and absorbed by the array, by tracking the electrode array's input impedance and by continuously adjusting the matching network to achieve the most efficient energy delivery between the source and the array. Figures 34, 35, and 36 illustrate the applied or input RF power to the array, the cumulative RF energy delivered, and the effective RF power source utilization, respectively, as function of time.

Both the forward and reflected RF power at the output of the RF power source were continuously monitored throughout the test. Additionally, the forward and reflected RF power was monitored at the input to the stage 1 matching network, adjacent to the array. By periodically adjusting the variable components of the stage 2 matching network, the reflected power to the RF power source was

Figure 34

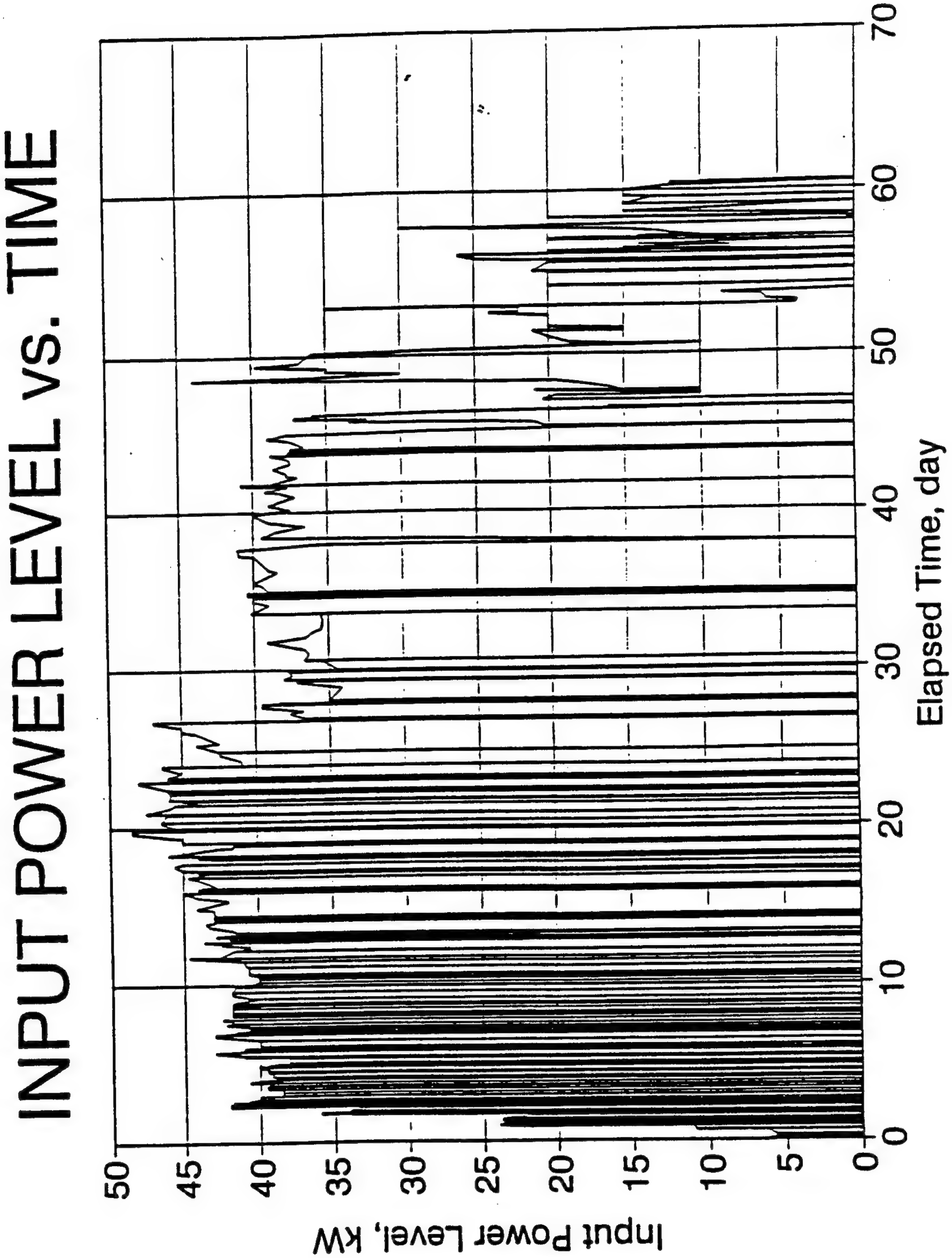

INPUT POWER LEVEL vs. TIME
Input Power Level, kW
Elapsed Time, day
0
5
10
15
20
25
30
35
40
45
50
0
10
20
30
40
50
60
70

Figure 35

CUMULATIVE RF ENERGY vs. TIME

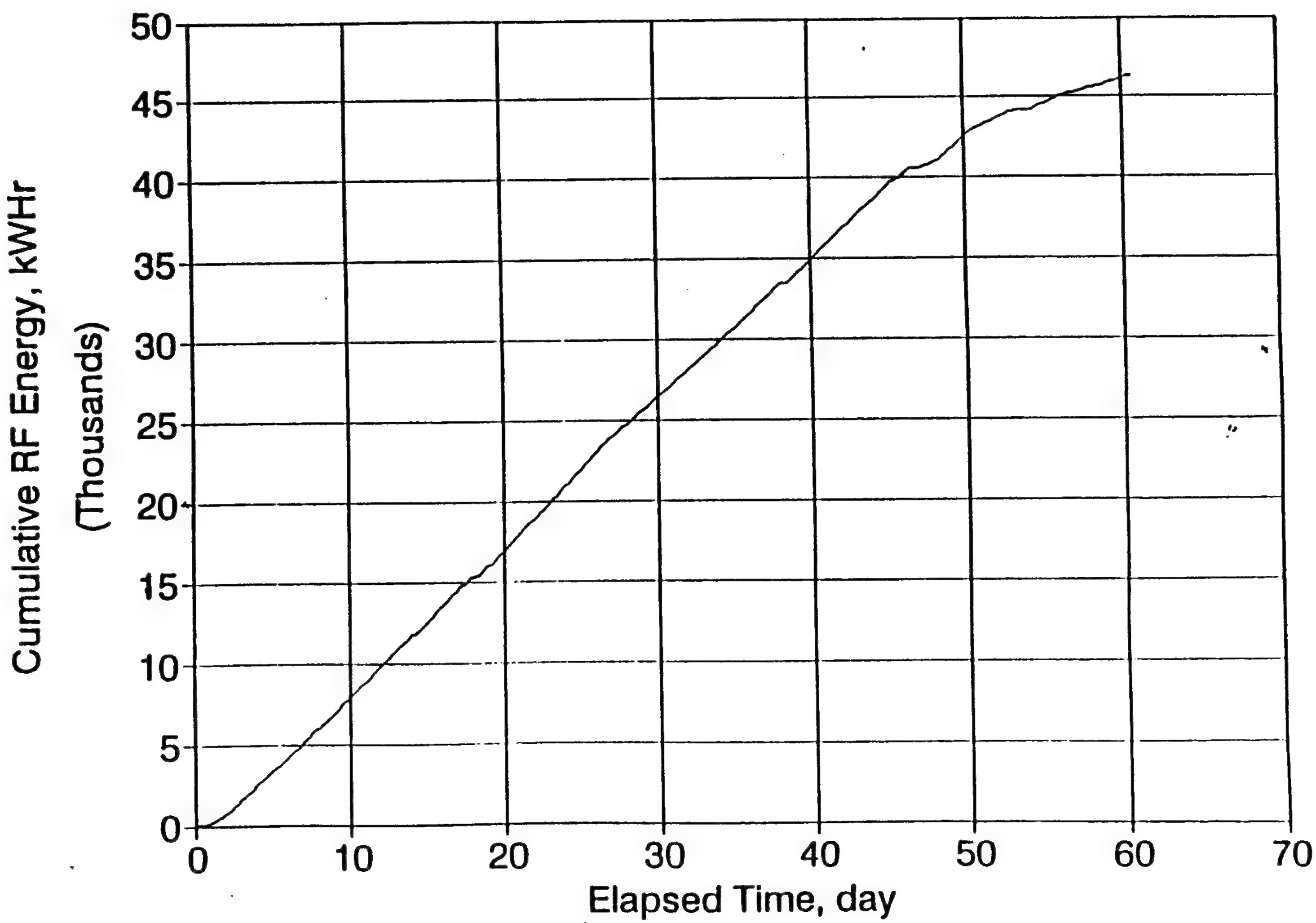
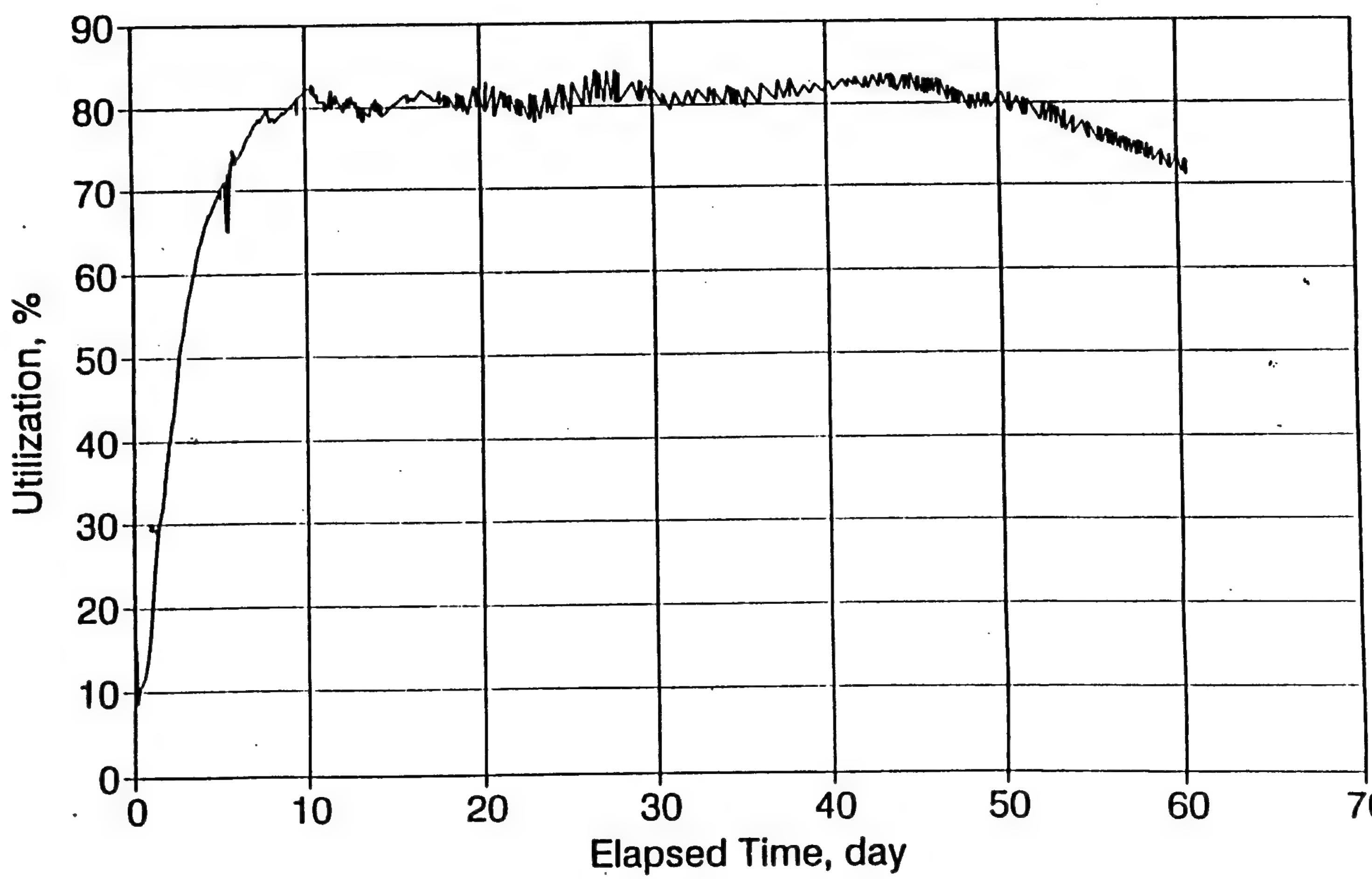


Figure 36

RF POWER SOURCE UTILIZATION vs. TIME

(Percent of Capacity)



minimized or maintained at zero. Finally, by recording the measurements obtained from the IITRI designed in-line impedance meter, changes in trends in the input impedance to the electrode array were tracked as a function of time. By monitoring the trends in this impedance, a qualitative assessment of the performance of the RF heating system was performed.

During the operation of the test it was determined that the use of the single RF frequency of 6.78 MHz would be sufficient. All subsequent RF data is for a fundamental applied frequency of 6.78 MHz. Figure 37 illustrates a calculated Smith chart representation of the array's input impedance as would be measured at the soil surface , if possible, as a function of time for the first 33 days of the demonstration test. During this period of the test, the track of the array's input impedance appears, for the most part, as would be expected for the RF heating of this specific triplate array. Figure 38 shows a calculated Smith chart representation of the array's input impedance at the soil surface for the final month of the test. The erratic pattern indicates that major impedance variations were occurring within the triplate array throughout the majority of the final two to three weeks of the heating.

2. RF Emissions Monitoring

Near and far-field electromagnetic field measurements were made at and around the test area. Near-field refers to the immediate vicinity of the test site (within ~15 feet of the array); far-field refers to locations 100 to 1600 meters from the test site. All far-field locations were selected in consultation with Kelly AFB communication personnel. The purpose of these measurements was to ensure that any radiated RF power levels were below permissible FCC and Air Force standards, that no interference was generated with base communications, and that no personnel safety problem areas existed.

These measurements were made in two different phases. The first phase or series of measurements were conducted before the initiation of the actual test by applying low RF power levels (~5 kW) to the electrode array and monitoring both near and far-field radio frequency interference (RFI) electric field intensity values in order to identify any potential problem areas. The second series of measurements were conducted during the test. These near and far-field RFI measurements were made while full power was being applied to the electrode array. Ambient field levels were measured by momentarily turning the RF source off to the electrode array at each measurement point or location.

Figure 8, previously illustrated an overview of the Kelly AFB; Site S-1 demonstration test layout. RFI safety measurements were

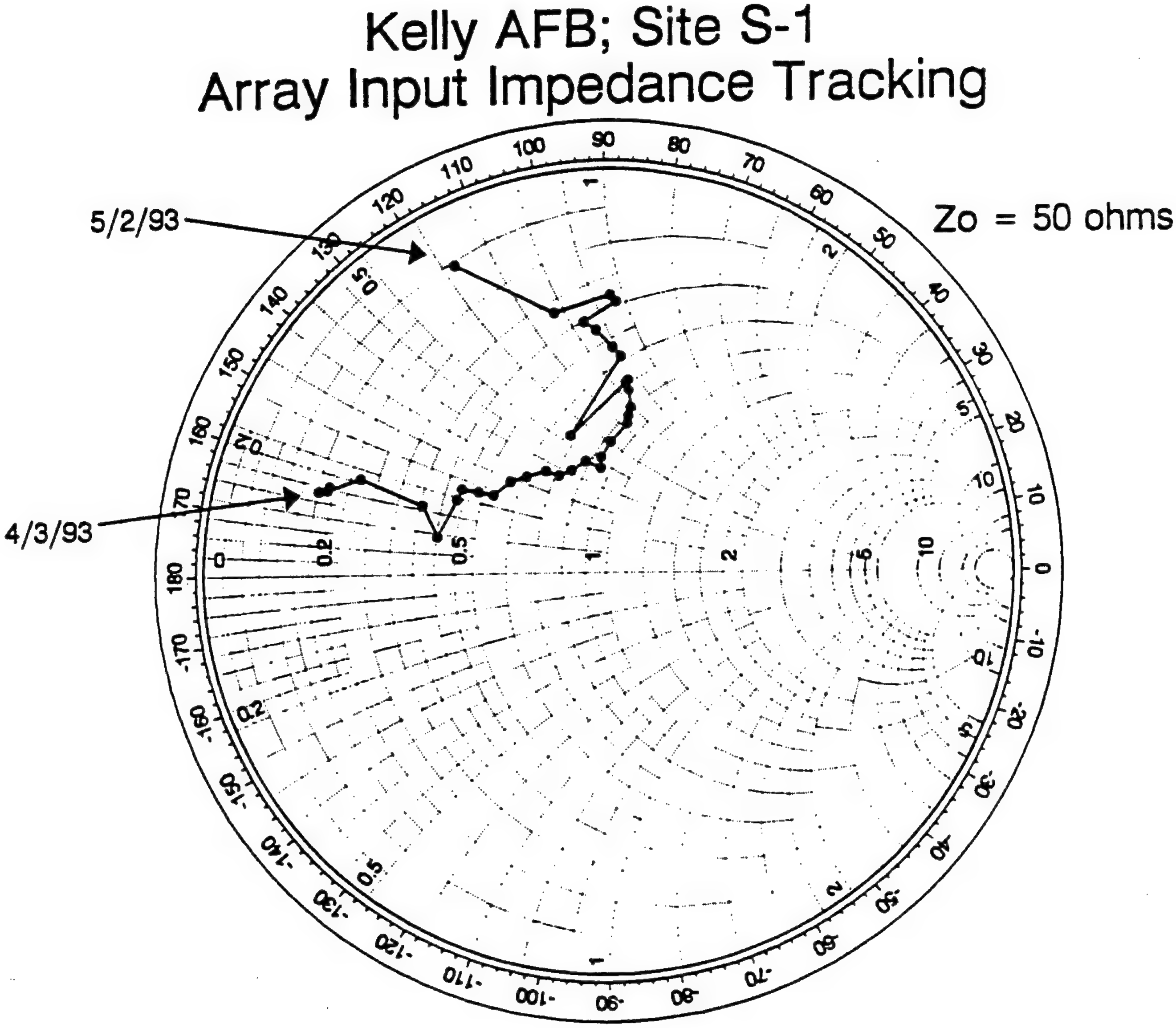


Figure 37. Kelly AFB; Site S-1.

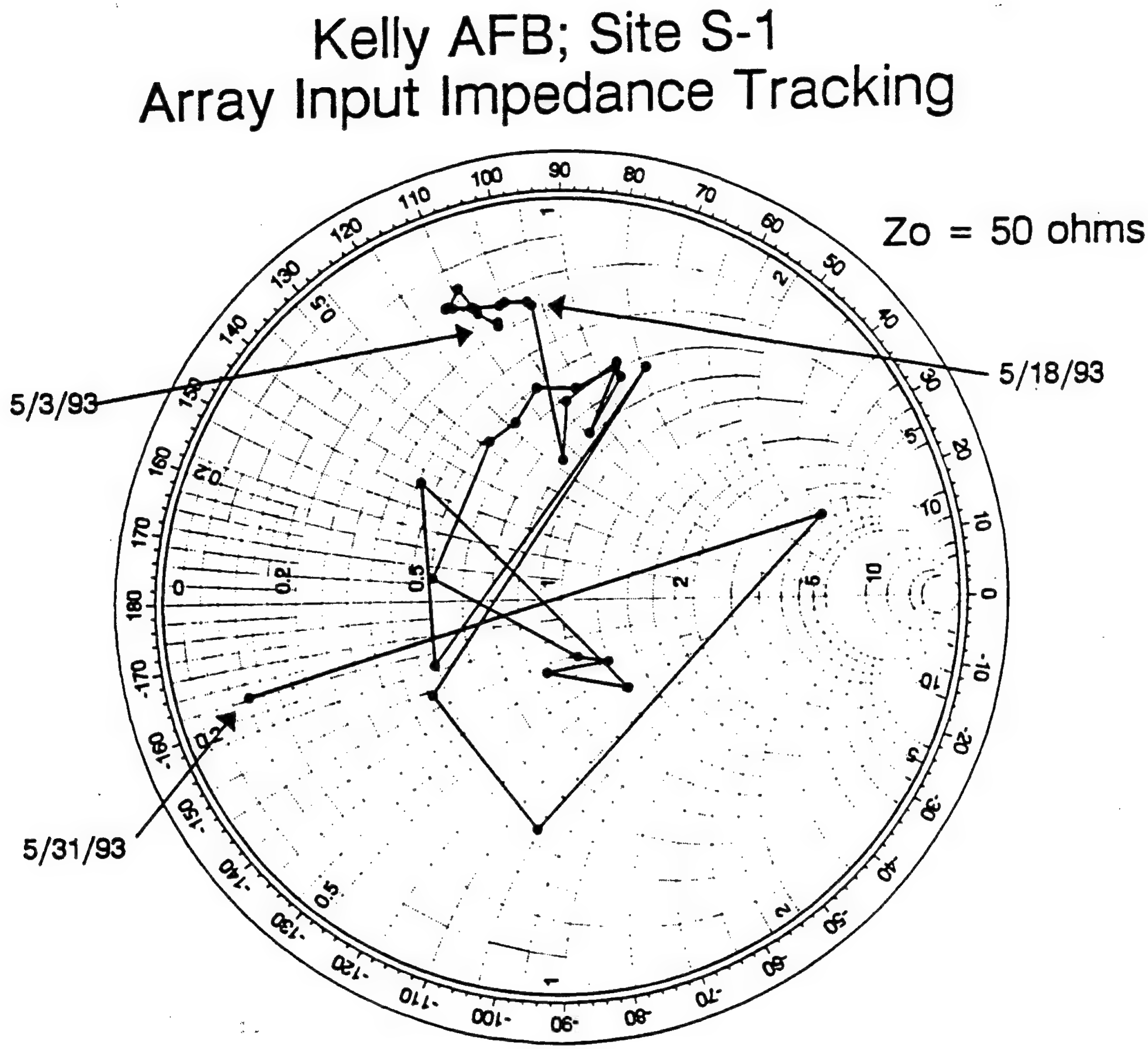


Figure 38. Kelly AFB; Site S-1.

conducted periodically during the test throughout the area shown in the figure. These safety measurements consisted of recording the RF power density as measured by a hand held RF field strength or exposure probe. The maximum measured RF power density was found just below the 6 ⅛ inch coax RF choke. The maximum value recorded at full power (40 kW applied to the array) was 0.16 mW/cm^2 which is less than 1% of the maximum permissible exposure limit (19.6 mW/cm^2 at 6.78 MHz) as identified by IEEE C95.1-1991 (Reference 5). There were no measurable RF power densities within the area except in the proximity of conducting materials. The average RF power density measured within 6 inches of the coaxial transmission lines was 4 $\mu W/cm^2$. This represents 0.02% of the permissible limit.

Table 19 contains the maximum measured electric field strengths for both near and far-field RFI safety measurements. Also illustrated in this table are the appropriate limits identified by the Institute of Electrical and Electronic Engineers (IEEE) and accepted by the American National Standards Institute (ANSI) and the National Institute of Occupational Safety and Health (NIOSH) for near-field continuous exposure to electric fields at this frequency of operation. The maximum measured electric field strength of 40 mV/m at a distance of 10 meters is more than three orders of magnitude below the minimum of these two ratings. In addition, no electromagnetic interference was experienced by any of the air base communication staff throughout the duration of the demonstration.

No out-of-band electric field strengths were measurable at frequencies that were not, themselves, ISM band frequencies. Out-of-band refers to measurements at frequencies other than the operating or fundamental frequency directly generated as part of its operation (harmonics, spurious radiation, etc.).

The fact that all RFI measurements, near and far-field met personnel safety limits and were within permissible standards, indicates that more than sufficient efforts were employed during the design, fabrication and installation of this demonstration test to insure adequate site personnel safety and not pose any interference to the surrounding community.

TABLE 19. RFI SAFETY MEASUREMENTS NEAR/FAR-FIELD
(APPLIED FREQUENCY = 6.78 MHz, APPLIED POWER = 40 KW)

Distance from Array (meters)	Electric Field Strength (millivolts/meter)	Personnel Safety Continuous Exposure Electric Field Strength Standards (Volts/meter)	
		IEEE/ANSI	NIOSH
10	40.0	121.5	192.
100	1.30		
400	0.071		
800	0.126		
1600	0.016		

VIII. CONCLUSIONS

A. TPH REMOVAL

In the central row of electrodes, the excitor Row B, high removal of TPH was observed due to the high temperature achieved in this row. The residual concentration of TPH in this row was in the range of 4 to 112 ppm. Higher concentrations were observed below the tips of the excitor electrodes (305 ppm) and towards the edges of the row where the temperature was lower. Thus, in thermowell TW2 the concentration range was 48 to 417 ppm and in TW1 it was 263 to 6543 ppm. The high reading in TW1 is probably an outlier as explained in Section VII. The average temperature in the excitor row ranged from 125°C to 650°C (Figure 21). The average temperature in this row was in the range of 125 to 150°C from 200 to approximately 700 hours of elapsed time. After 700 hours, the temperatures at the tips of the excitor electrodes shot up and so did the average.

The results of the Bench Scale Treatability study (Reference 2a) had shown that treatment at a temperature of 150°C with a residence time of 100 hours was sufficient to reduce the TPH concentration to 60 to 90 ppm. The percent removal depends upon the initial concentration of soil and it ranged from 75 to 97 percent in the laboratory studies. Thus, the residual concentrations observed in Row B were consistent with the results of the treatability study.

Comparison of the initial and final concentrations of samples obtained from Row B indicate that there was a 84 percent reduction of TPH concentration. We have omitted the outlier in this calculation. If all the data points are considered, including the outlier, then the reduction in TPH concentration is only 12 percent.

The residual concentration of TPH in ground Row C was in the range of 5 to 5700 ppm. There were 12 post demonstration soil samples. Of these 2 were in the depth range of 20 to 24 ft which is below the tips of the excitor electrodes and they may have also been very close to, if not below the water table surface. These two samples had a concentration of 2800 to 2840 ppm. The average temperature in ground rows A and C at a depth of 24 foot did not exceed 45 to 50 °C (Figure 22). Thus the above results are not surprising considering the sample locations and the temperature history.

There were another two samples, in the depth range of 18 to 20 ft, with residual TPH concentration in the range of 1100 to 5700 ppm. There are no temperature data in the depth range of 18 to 20 ft. But by interpolating between data of depth ranges 12 and

24 ft, one can see that the temperature in the depth range of 18 to 20 ft was in the range of 45° to 70°C.

The remaining 8 samples of Ground Row C were from the depth range of 0 to 16 ft. with a residual TPH concentration in the range of 5 to 210 ppm with an average of 64 ppm. The initial concentration of these 8 locations was in the range of 25 to 896 ppm with an average of 221 ppm. Thus, the percentage removal in the 0 to 18 ft depth interval of Row C was 70 percent. If all the samples of Row C are considered in the calculations of initial and residual average concentrations then the following results are obtained: Initial average concentration: 2271 ppm, and final average concentration: 1079 ppm for a reduction of 52.5 percent.

The concentration data for ground Row A is more difficult to interpret because of the way the sampling points happen to fall in relation to the water table, and the extent of the heated zone. It was pointed out earlier that most of the samples were taken from area where the temperature rise was inadequate or else they were taken close to the water table. The average concentration of all the 11 pre-demonstration soil samples in Row A was 1340 ppm. The average of all 10 post-demonstration soil samples was 1478, indicating either that the TPH was not removed or it increased slightly. In both Rows A and C the hottest soil region was opposite electrodes in positions 3 to 6, that is A3 to A6, etc. In Row A, there were only 3 post demonstration samples from these electrodes, of which two were in the depth interval of 18 to 20 ft. where the temperature rise was inadequate to remove TPH. In Row A there were 7 post-demonstration samples taken from locations which were either too deep or else were in the fringe area where the temperature rise was insufficient.

The results of the soil sample analysis when considered in relation to the sample location and the temperature history support the conclusion that where ever the soil was heated to a temperature range of 150°C, low residual concentration of TPH was obtained.

B. SOIL TEMPERATURE RISE

As illustrated by the data presented in the figures of Section VII it is clear that the central row of electrodes were abnormally overheated whereas there was severe under heating of zones further removed from the central row of electrodes. The design goal was to heat 122 cu. yd. to a temperature of 150°C. The results show the following:

- Volume of soil where every measurement point exceeded 100°C for long (>100 hr) periods of time was estimated to be 90 cu. yd.

- volume of soil where the average temperature was >150°C was estimated to be 56 cu. yd. But volume within which every measurement point exceeded 150°C was 34 cu. yd.

- Volume of soil where the average temperature was in the range of 60° to 70°C was 37 cu. yd.

These results indicate that the desired volume of soil did not reach the temperature objective of 150°C. The main reason for this was the melting of electrode due to their close proximity to the water table.

The high temperature to which the soil was heated may have contributed to some oxidation of contaminants present in the soil. IITRI has no data to prove or disprove this hypothesis, but it is a reasonable one to make.

C. OPERATION OF THE RF HEATING SYSTEM

After May 18, 1993, sustained operation of the RF power source became difficult. The analysis of data and information now available show clearly that this was due to the high temperature achieved in the central row which led to the melting of the electrodes. Prior to this time the RF system performed quite well considering that the RF power source was 40 to 45 years old and it exhibited signs of age as evidenced by frequent short circuiting due to insulation failure and rectifier problems. However, the matching networks and instrumentation all performed as expected.

It is probable that the electrodes melted due to their close proximity to the water table. But depth of water table below the heated zone is not known in the time period that the demonstration was performed. Due to the design of the array, it was not possible to monitor the water table location. However, water table depth was monitored prior to completion of the electrode array. These data indicate that the water table was 2.5 ft to 3.5 ft below the tips of the excitor electrode in February 1993. The water table level was controlled by means of four dewatering wells that pumped continuously during system installation and operation. It is known that the pumps were able to reduce the water table depth by 1 to 1.5 ft during the nine days ending February 11, 1993.

The measurements of radiated power levels indicated that there were no RFI problems. Safety measurements made in the immediate vicinity of the RF equipment indicated safe levels of E and H fields.

IX. RECOMMENDATIONS

In light of the results of the field demonstration the following recommendations are made:

- Develop, through engineering analysis, sound and reliable criteria which dictate the proximity of the electrode tips and the water table

- For sites which have a shallow water table, means of measuring, while heating, the depth of the water table below the electrode array must be incorporated in the design of the array.

- A review of the impedance data plotted on Smith charts indicates that there were clues developing prior to May 18, 1993, which may have been indicative of the problems which we were to experience in the future. An engineering analysis should be done to catalogue such clues so that the system operating personnel can be alert to the possible mal-operation of the system.

- An analysis of the radiation measurements from the heated zone indicate that the RF shield may have been over designed. Future demonstrations should evaluate other simpler alternatives for the shield design.

- Temperature of the thermowells was measured by means of fiber optic probes. These probes were found to work reliably at temperatures below 200°C. However, for higher temperatures the probes failed due to material failure. Alternative probes should be sought.

- The RF system does not lend itself to an elegant and economical way of measuring temperature of the soil between the two outer rows of electrodes. Due to this reason, thermocouples were inserted inside the excitor electrodes and thermowells were installed. Thermocouples inside the excitor electrodes were read by switching off the RF power. The reason is that no electrical conductor may leave the heated area when the RF power is on. Recent developments in fiber optic tele-metering should be investigated to develop a continuous temperature logging system for both soil and electrode temperatures.

- Means of recovering hot gases and vapors from the excitor electrode row or other central area of the array should be developed. When hot vapors are collected from the

ground rows, they cool and some fraction of these may condense there, depending upon the local temperature and the dew point.

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Appendix A

SUMMARY OF LOG BOOK ENTRIES FOR RF HEATING

Appendix A

SUMMARY OF LOG BOOK ENTRIES FOR RF HEATING

Table A-1 summarizes the high lights of the log book entries made by the shift operators during the in situ RF heating experiment. These entries pertain to the operation of the RF power source and the thermal data logging system. It should be noted that the experiment was performed with a 40 kW power source which is at least 45 years old and is prone to breakdowns related to age.

TABLE A-1. SUMMARY OF LOGBOOK ENTRIES

Date	Time	Logbook		Individual	Summary of Logbook Entry	
		Number	Page			
04-04-93	21:00	30583	4	Bajzek	Recorded warming of the exciter row thermocouple jacks in the plexiglass housing. Estimated temperature 40°C.	
04-05-03	17:55	30583	5	Suchanek	Heard loud noises from the power source FR7-6.	
04-06-93	13:10	30583	6	Jones	Start full power RFI measurements.	
04-08-93	02:42	30583	8	Suchanek	RF wave form has modulation. Rectifier tube changed.	
04-09-93	00:25	30583	9	Suchanek	Lost power. Sam called. Down for 75 minutes.	
04-10-93		30583	10		Thermocouple connectors for excitor T/C are hot. Tried shielding with Teflon. Plug for B1A is turning black.	
04-10-93	15:00	30583	10		Teflon does not help reduce heating of T/C plugs. Teflon removed.	
04-11-93	23:00	30583	11	Jones	FRJ-T has been down for 4 hours. Switching interlock system to the new power source. Sparking observed at the rear of the third cabinet of FR7-6. Teflon shield applied.	
04-14-93		30583	13	Jones	Match is moving more rapidly than before.	
04-14-93	14:50	30583	13	Jones	Reflected power moved up to 500 watts in a period of 10 minutes.	
04-17-93	17:09	30583 2875 (D)	17 12	Tumarkin Kunstmanas	Arcing under rectifier sockets. Short in C1585 air type capacitor.	
04-18-93	00:05	30583	16	Kunstmanas	HNUS equipment lost power. Power (RF) off. Waited 1-hr. after HNUS power was restored before powering up with RF.	
04-18-93	06:40	30583	16	Kunstmanas	Arcing in transmitter. Shut down.	
04-20-93	19:51	30583 D2875	19 13	Kunstmanas	Problems with transmitter.	
04-21-93	11:26	30583	20		Arcing in the transmitter.	
04-22-93	08:10	30583	20		Arcing in the transmitter.	
04-22-93	1:28	30583	20		Transmitter was shut down because power dropped "radically" 35 to 31 kW then to 20 kW.	
04-23-93	20:29	30583	22		Transmitter tripped off. Circuit breaker tripped. Interlock light on. Breaker reset. Could not find open interlock switch. At 9:08 p.m. light off on its own.	
04-24-93	01:00	30583	22		Interlock opened somewhere. Bypassed. Resume power input to array.	

TABLE A-1. SUMMARY OF LOGBOOK ENTRIES

Date	Time	Logbook		Individual	Summary of Logbook Entry	
		Number	Page			
04-24-93	20:56	30583	23		Arcing in transmitter. Shutdown. Restarted. Sam investigated.	
04-25-93	02:40	30583	23	Suchanek	Over-voltage trip. Shut down. Could not restart. PA motorized switch banged with screwdriver handle. Restarted OK.	
04-25-93	09:35	30583	24	Tumarkin	Shut down to repair the motor driven PA high-voltage breaker.	
04-26-93	00:10	30583	24		Tripped rectified tube was replaced. Down for 80 minutes.	
04-26-93	15:25	30583	24		Watt-hour meter on HNUS transformer was repaired. Reads 0000.	
04-27-93	15:45	30583	25		Read watt hour meter: 1,737.5 kW hr. = 71.41 kW.	
04-28-93	11:05	30585	1		Wave form is "wavy". High voltage rectifier tube out.	
04-29-93	02:20	30585	1		Arcing in transmitter, rear of 3rd cabinet.	
04-29-93	08:20	30585	2		Hard rain. Ponding of water.	
04-30-93		30585	3		Fog. Lots of moisture in air.	
04-30-93		30583	3		Shut down for changes to matching network. Removed bullet capacitor. Change internal capacitor.	
05-01-93	03:30	30585	3	Suchanek	Waveform has a ripple. Replaced 2 rectifier tubes. Down for 3 hrs.	
05-01-93	05:15	30585	3		Rich reported that excitor T/C connector for B1A crumbled.	
05-01-93	10:10	30585	4	Tumarkin	Tested new transmitter into dummy load.	
05-01-93	16:50	30585	4	Tumarkin Jones	Restarted after shut down. T/C wiring was removed and pulled back from the plexi-glass housing. Now the exciter electrode T/C wing has been wound and tied to the center conductor inside the dog house.	
05-01-93	17:45	30585	4	Jones	Transmitter tripped. Small amount of smoke.	
05-02-93	11:15	30585	5		Power down from 11:15 to 00:15 a.m.	
05-03-93	07:40	30585	5		Excitor T/C plugs were replaced.	
05-05-93	04:05	30585	6		Very heavy rain. Rained all day till about 6 p.m. 6" rainfall at San Antonio airport.	
05-06-93			6	Dev	During morning excitor T/C measurement B2A was 253°C. Vapor barrier temperature near TWI bundle was 120°C.	
05-06-93	23:06	30585	7		One T/C in excitor row, B2A, over 300°C.	

TABLE A-1. SUMMARY OF LOGBOOK ENTRIES

Date	Time	Logbook		Individual	Summary of Logbook Entry	
		Number	Page			
05-08-93	07:00	30585	8	Tumarkin	Transmitter down for 3 hrs., 45 minutes.	
05-09-93	15:15	30585	8	Dev	Temperature of vapor barrier was measured. T = 119°C under thermal insulation blanket 18" north of electrode B2. T = 72°C on exposed vapor barrier at B2. (Thermal blanket on top of B2 removed at some prior time.)	
05-10-93	15:20	30585	9		Vapor barrier temperature above B2 - 78°C. 1' north of B2, under blanket 120°C.	
05-11-93	07:20	30585	9		Vapor barrier temperature about the same as the measurement shown in line above.	
05-11-93	15:25	30585 D2877	10 3		B2A was 741.5°C @ 15:25.	
05-11-93	15:30	30585	9		Vapor barrier temperature above B2 : 78°C 1' foot north: 128°C; 2 ft. north 100°C.	15:25, 05-11-93 B2A - 742°C.
05-11-93	16:30	30585	10	Ase	Power down. Power down for ≈ 12 hrs. Resume power to soil at 03:55 hrs. 05-12-93.	
05-12-93	03:55	30585	10	Ase	Power on.	
05-12-93	23:00	30585	10		Vapor barrier temperature 60°C (exposed surface) 125°C under blanket, 2 ft. north.	22:55, 05-12-93 B2A = 869°C.
05-13-93	15:20	30585	11		Vapor barrier temperature 50°C on exposed surface. 120°C under blanket 2 ft. north	15:09, 05-13-93 B2A = 895°C.
05-13-93	23:07	30585	11		Vapor barrier, exposed surface 59°C. 2 ft. north, under blanket 119°C. Power tripped. Resume at 01:40. Ran at 10 kW prior to 1:40, while waiting for Sam.	
05-18-93	11:15	30585	14		High winds; very heavy rain; power in trailer is flickering.	
05-18-93	17:05	30585	14		Reflected power meter moving up and down. Matching network adjusted many times for match.	Max temp. in exciter row = 835°C @ B2A, 15:12 hrs.
05-18-93	18:00	30585	14		Transmitter shut down. Reflected power increased to 4 kW. Called Sam.	
05-19-93	19:00	30585	15	Suchanek	Running at 35 kW. Constant adjustment of match for the last 4 hours.	B2C had no reading at 22:51 hrs, 5-19; B3C unstable.
05-20-93	06:25	D2877	17		Power turned off	B2C, 5/20, 0708 was 1330°C
05-20-93	18:30	30585	15	Suchanek	Power on at 20 kW. (Power was off from 06:25 to 18:30 hrs).	
05-20-93	20:00	30585	15		Many adjustments necessary to match. ~ every 5 minutes.	
05-20-93	21:15	30585	15		Stable	
05-20-93	23:45				Reflected power jumped to 1 kW. Decreased power to 10 kW.	

TABLE A-1. SUMMARY OF LOGBOOK ENTRIES

Date	Time	Logbook		Individual	Summary of Logbook Entry	
		Number	Page			
05-21-93	01:10	30585	15	Dev	Reduced power to 10 kW from 20. Reflected power 0 to 1 kW. Phase angle fluctuations.	
05-21-93	05:30	30585	15	Dev	Power increased to 15 kW.	
05-21-93	13:15	30585	16	Tumarkin	Match is very unstable. Power at 15 kW.	
05-21-93		30585	16		Reference to restarting power time?	
05-22-93	~06:50	30585	16	Kunstmanas	Spent the whole shift gradually bringing power up to 39 kW.	
05-22-93	17:20	30585	16		Thunderstorm, heavy, but short duration.	
05-23-93	05:30	30585	17		Heavy rain for about 30 minutes.	
05-23-93	07:30	30585	17		Heavy rain. Dog house an island. Radio reports 7" of rain.	
05-23-93	20:00	30585	17		Large increase in reflected power, up to 3.8 kW refl. matched to zero. Large change in vector voltmeter readings. Rain ends at 18:00 hrs.	
05-24-93	17:30	30585	17		Power decreased to 20 kW. Reflected power fluctuating.	
05-24-93	22:15	30585	18	Sabato	Stable at 20 kW so tried to increase power up to 25. Became unstable. Backed off to 20 kW.	
05-25-93		30585	18		While at 21 kW reached the limit on capacitor C1. Backed down to 15 kW.	B1C = 1070°C, 5-25-93, 23:08 hr.
05-26-93	09:50	30585	18		Do not increase power beyond 7 kW per Dev.	B3C = 1018 @ 5-26-93, 07:22 hr.
05-28-93		30585	19		New instructions from Dev	
05-28-93		30585	19		New instructions from Dev	
05-28-93		30585	19		Transmitter down form 16:10 to 18:40 hr.	
05-29-93	00:55	30585	19		Reflected power jumped to 2 kW. Then 40 kW circuit breaker tripped. Restarted; rematched; stable.	B4C - no reading, 5-29-93, 13:00 hrs.
05-30-93		30585	20		Very hard rain. Very windy. No entries in logbook C30585 for 6-1-93 or 6-2-93.	
06-03-93	11:00	30585	20		Safety measurements were made prior to shut down.	
06-03-93	12;00	30585	20		RF power off.	

APPENDIX B

SOIL TEMPERATURE DATA

Appendix B

SOIL TEMPERATURE DATA

This appendix contains four tables which have temperature data obtained during the field demonstration:

Table B-1 has temperature data from the two outer rows of electrodes and the outside thermowell TW7.

Table B-2 has temperature data from all the thermowells which were inside the heated zone.

Table B-3 has temperature data measured by thermocouples installed inside the four center row electrodes, the excitor electrodes.

Table B-4 has the temperature data from the data logger. These temperatures were measured in the ground row electrodes and the outside thermowell TW7

The physical location of all the temperature measurement points can be found by referring to the attached Figure B-1, which is a plan view of the electrode array showing the electrode and thermowell numbering system. The temperature measurement point have a number designation composed of tw^ parts: the first part is the number of the electrode or the thermowell. T second part is the depth code. A typical measurement point designation in the excitor row is of the type B1A, B3C, B4B etc. B1A refers to a measurement point in the B1 electrode at a depth 1-ft, which has a depth code of A. B3C means electrode B3 at a depth of 19 ft which has a depth code of C. Similar numbering system is used for temperature measurement points in the two ground rows and the thermowells. The following table defines the depth codes.

Depth Code Letter	Ground Rows A & C	Excitor Row B	Thermowells
A	1 ft	1 ft	1 ft
B	12 ft	10 ft	12 ft
C	24 ft	19 ft	24 ft
D	29 ft	-----	29 ft
E	-----	-----	31 ft
F	-----	-----	34 ft

Figure B-1

ELECTRODE HOLE AND THERMOWELL LAYOUT

(Plan)

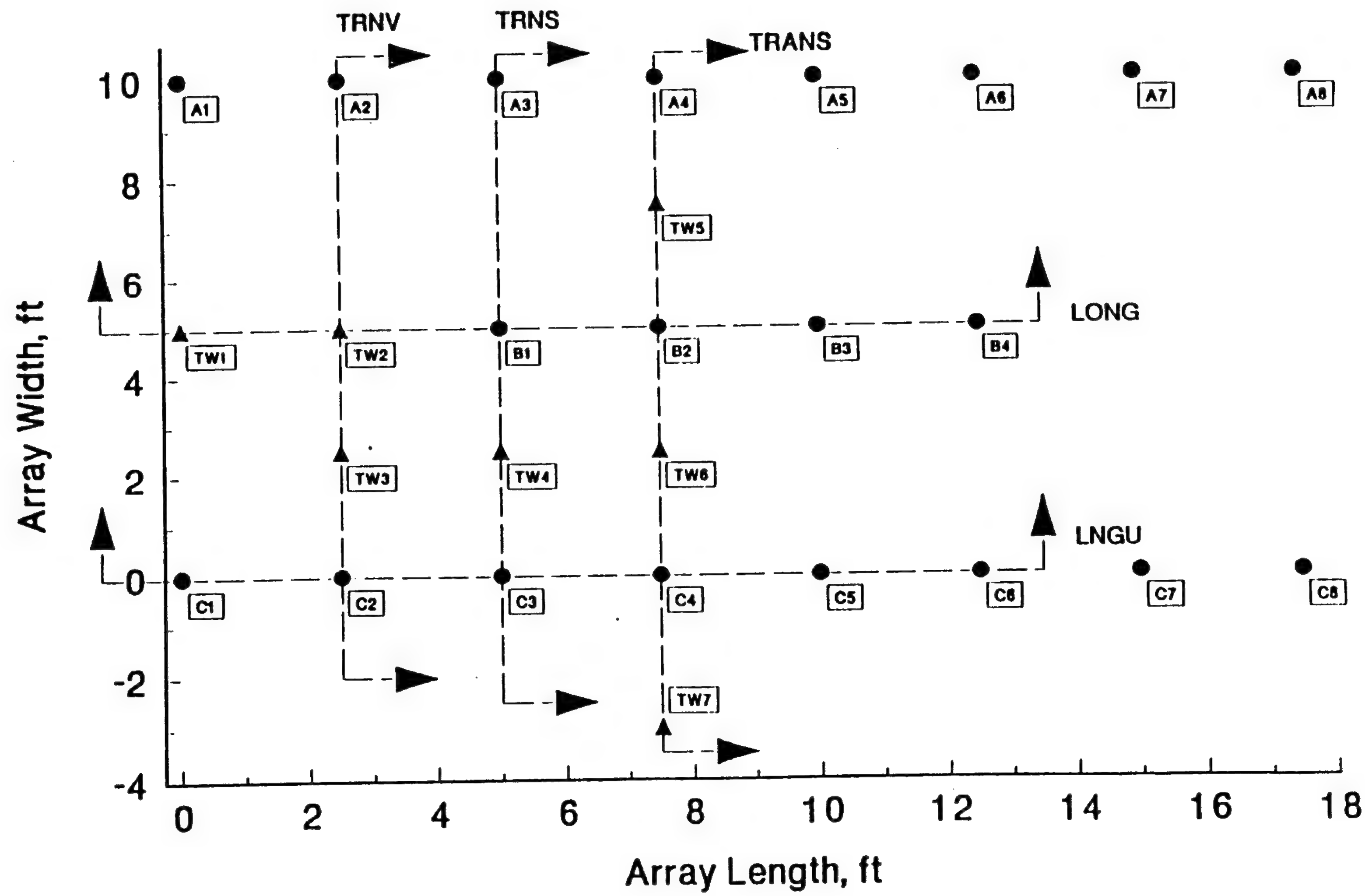


Table B-1 Ground Electrodes and Outside Thermowell (TW7) Temperature (Recorded Manually)

Date	Time	Elapsed Time	A2A 1-ft	A3A 1-ft	A4A 1-ft	C2A 1-FT	C3A 1-ft	C4A 1-FT.	A2B 12-ft	A3B 12-ft	A4B 12-ft	C1B 12-FT	C2B 12-ft	C3B 12-ft	C4B 12-FT.	C6B 12-FT	A2C 24-ft	A3C 24-ft
Maximum Temp. --->			79	86	112	82	98	92	84	95	96	68	84	99	96	91	42	45
04/03/93	16:40	0.00																
04/03/93	17:00	0.33	17.9	18.2	18.1	18.2	18.5	18.8	19.5	19.8	19.5	19.1	19.0	19.8	19.8	21.0	21.7	21.8
04/04/93	17:10	24.50	19.7	21.0	22.7	19.6	21.6	23.3	19.4	19.8	19.4	18.9	18.9	19.7	19.7	20.9	21.8	21.9
04/05/93	19:00	50.33	23.9	25.9	32.4	22.8	27.6	32.7	19.4	19.8	19.3	19.0	19.2	19.9	19.9	20.9	21.8	21.8
04/06/93	17:30	72.83	27.8	30.5	40.4	25.7	32.5	37.4	19.6	20.1	19.9	19.1	19.3	20.3	20.4	21.3	21.9	22.2
04/07/93	22:10	101.50	32.5	36.5	49.2	29.8	38.0	43.8	19.9	20.7	20.8	19.1	19.4	21.2	21.5	22.1	22.0	22.2
04/08/93	21:20	124.67	35.6	41.4	54.1	33.3	43.3	49.9	20.4	21.6	22.0	19.3	20.2	22.5	23.4	23.3	22.2	22.2
04/09/93	21:40	149.00	37.7	45.2	58.4	36.1	47.6	54.2	21.0	22.8	24.3	19.6	21.0	24.6	26.6	25.1	22.3	22.4
04/10/93	17:45	169.08	39.2	47.7	60.7	37.7	50.9	56.8	21.8	24.1	27.0	19.7	21.6	26.6	30.2	26.9	22.3	22.5
04/11/93	18:10	193.50	41.1	50.5	62.5	40.3	54.0	58.9	23.0	26.4	30.7	20.2	23.2	29.7	35.0	29.7	22.7	22.8
04/12/93	18:51	218.18	42.7	53.2	65.3	42.0	57.2	61.6	24.3	28.8	34.7	20.9	24.9	33.1	39.2	32.8	22.7	23.0
04/13/93	03:45	227.08	43.3	54.3	66.9	42.6	58.5	62.7	24.8	29.8	36.6	21.4	25.3	34.5	40.9	33.8	22.6	23.0
04/14/93	05:55	253.25	44.9	57.1	68.3	44.3	61.2	64.4	26.5	32.9	41.6	22.2	27.2	38.6	46.0	36.9	22.8	23.4
04/15/93	07:00	278.33	45.9	59.0	69.5	45.7	62.8	65.4	28.7	36.3	46.9	23.0	29.6	42.7	50.9	40.4	23.1	23.6
04/16/93	08:45	304.08	46.6	59.3	69.1	46.3	63.6	66.0	31.0	40.4	52.9	24.4	32.6	47.1	56.1	42.5	23.2	24.1
04/17/93	08:29	327.82	47.0	60.0	69.5	46.9	64.0		33.2	43.8	57.4	25.3	35.0	51.7	61.6	45.3	23.4	24.1
04/18/93	07:48	351.13	47.3	60.4	68.6	47.0	63.5	64.7	35.5	47.0	61.0	26.6	37.0	56.2	66.4	48.2		24.3
04/19/93	06:40	374.00	48.4	61.9	70.7	48.6	65.2	66.3	37.7	50.4	65.0	27.9	39.4	60.0	73.0	49.9	23.9	24.6
04/20/93	08:46	400.10	49.7	63.4	72.2	50.3	66.7	67.2	40.2	54.1	69.3	29.4	42.3	64.3	78.6	52.5	23.7	24.8
04/21/93	09:00	424.33	50.1	63.9	73.0	51.8	66.7	66.8	43.1	57.6	72.9	31.2	45.2	68.4	81.5	53.8	24.1	25.2
04/22/93	09:18	448.63	50.7	62.9	73.2	52.7	66.9	69.3	45.6	60.9	75.8	32.9	47.7	71.5	83.8	56.2	24.4	25.6
04/23/93	08:00	471.33	51.5	63.5	74.5	54.8	70.3	70.5	48.0	63.7	78.0	34.5	50.1	74.6	86.1	57.8	24.8	26.0
04/24/93	09:15	496.58	52.6	65.1	76.6	56.5	71.6	71.4	50.3	66.6	80.5	36.0	52.6	77.4	89.6	62.4	24.9	26.2
04/25/93	06:42	518.03	54.2	65.7	78.9	58.6	73.0	73.9	52.8	69.2	82.7	37.6	55.1	79.8	91.6	61.9	25.3	26.5
04/26/93	07:15	542.58	57.4	68.0	81.4	60.9	78.2	76.4	55.2	71.6	84.8	39.7	58.1	81.6	93.1	64.8	25.8	27.0
04/27/93	11:05	570.42	59.4	66.9	86.4	63.3	81.3	82.0	57.8	75.0	87.2	41.7	60.7	85.4	95.3	66.6	26.0	27.5
04/28/93	08:00	591.33	61.8	67.9	91.0	65.6	90.5	83.7	60.0	77.2	88.2	43.5	62.2	90.1	96.2	67.2	26.5	27.9
04/29/93	08:20	615.67	63.0	70.4	95.5	68.1	96.1	85.3	62.4	79.4	89.7	45.4	65.3	98.5	96.3	69.0	27.1	28.3
04/30/93	09:00	640.33	63.6	71.3	86.2	68.8	94.7	81.5	64.6	82.3	92.8	47.2	67.6	95.5	87.9	67.5	27.1	28.8
05/01/93	11:36	666.93	63.6	70.1	82.9	69.3	88.4	76.1	66.0	84.1	92.6	48.7	68.6	88.7	90.0	64.9	27.6	29.3
05/02/93	09:20	688.67	61.4	67.4	78.1	67.1	83.1	72.4	66.7	82.9	85.4	50.6	69.7	83.6	85.1		28.5	30.0
05/03/93	12:21	715.68	62.0	73.3	80.5	68.1	89.0	75.0	67.5	85.7	90.0	51.1	69.3	90.2	87.9	66.2	28.3	30.2
05/04/93	15:59	743.32	65.2	84.5	83.0	71.2	91.9	80.7	70.2	89.2	92.1	52.8	71.3	93.2	91.2	68.9	29.2	31.0
05/05/93	07:09	758.48	67.3	85.8	83.8	72.8	94.1	83.2	71.7	90.4	92.4	53.8	72.7	95.5	92.5	69.8	29.5	31.0
05/06/93	08:12	783.53	68.9	82.1	83.6	75.9	94.1	85.7	73.8	91.8	92.4	55.3	74.1	94.6	91.8	70.1	29.8	31.5
05/07/93	21:05	820.42	70.8	79	86.2	75.7	94.2	88.4	76.3	92.9	94.5	57.4	76.4	95.0	92.1	71.6	30.4	32.0
05/08/93	18:12	841.53	70.6	76.8	84.2	76.4	92.5	88.0	76.7	92.1	93.4	58.3	76.8	93.2	89.9	70.5	30.4	32.2
05/09/93	06:04	853.40	72.0	77.5	85.8	77.7	94.1	89.3	78.0	93.0	94.4	59.0	77.4	94.7	91.8	73.1	30.8	32.6
05/10/93	10:11	881.52	73.5	79.6	86.7	80.3	94.6	90.8	79.8	93.8	94.9	60.4	78.5	94.2	88.8	74.0	31.0	33.1
05/10/93		893.30	74.4	80.9	87.6	81.0	95.3	91.5		94.1	94.8	60.9	79.3	95.0	88.9	75.0	4	33.1

Table B-1 Ground Electrodes and Outside Thermowell (TW7) Temperature (Recorded Manually) [Continued]

Date	Time	Elapsed Time	A2A 1-ft	A3A 1-ft	A4A 1-ft	C2A 1-FT	C3A 1-ft	C4A 1-FT.	A2B 12-ft	A3B 12-ft	A4B 12-ft	C1B 12-FT	C2B 12-ft	C3B 12-ft	C4B 12-FT.	C6B 12-FT	A2C 24-ft	A3C 24-ft
Maximum Temp. --->			79	86	112	82	98	92	84	95	96	68	84	99	96	91	42	45
05/11/93	09:14	904.57	75.2	80.9	87.3	81.5	95.0	91.5	80.8	93.5	95.1	61.7	79.3	94.5	92.6	73.1	31.3	33.7
05/12/93	12:24	931.73	73.2	78.7	82.8	74.2	92.3	87.7	79.9	92.1	92.1	62.1	79.4	92.0	88.3	74.5	31.6	33.9
05/13/93	09:30	952.83	75.3	83.0	86.4	78.2	95.0	88.5	80.8	93.8	94.5	63.2	81.0	94.8	92.2	78.9	32.6	34.7
05/14/93	04:00	971.33	76.3	82.4	86.6	78.0	94.1	88.9	81.8	94.2	94.1	64.0	81.7	94.1	86.8	75.2	33.2	35.3
05/15/93	09:21	1000.68	77.4	84.0	88.3	78.1	95.0	89.0	82.4	92.3	95.5	64.8	82.3	94.7	92.9	75.4	33.2	36.1
05/16/93	15:43	1031.05	78.2	84.6	89.0	77.8	94.8	89.6	82.9	95.0	95.7	65.5	82.7	94.4	93.9	81.2	34.1	37.0
05/17/93	23:27	1062.78	79.3	85.8	90.0	80.3	95.4	89.9	83.2	94.7	96.2	67.1	83.5	95.5	92.6	88.5	35.6	38.4
05/18/93	09:50	1073.17	78.8	85.5	89.4	79.1	97.9	89.7	84.4	95.0	96.2	67.3	83.7	94.8	93.7	90.6	35.6	38.9
05/19/93	01:53	1089.22	77.7	83.5	87.3	78.0	93.5	87.3	83.0	93.2	94.2	67.8	84.1	93.6	91.2	84.5	36.4	39.4
05/19/93	23:58	1111.30	75.9	82.2	85.6	76.3	92.9	84.1	81.6	91.8	92.2	67.9	81.2	93.1	89.0	79.0	37.2	40.1
05/20/93	23:24	1134.73	72.2	80.1	83.8	73.3	90.2	81.9	79.6	85.3	90.6	67.9	78.7	91.2	88.1	78.8	37.8	40.6
05/22/93	22:00	1181.33	70.9	77.7	82.1	67.3	90.9	82.2	78.1	88.9	90.5	67.9	79.6	91.2	87.7	75.9	38.8	41.9
05/23/93	10:48	1194.13	71.4	78.5	80.7	70.2	90.7	81.8	77.7	88.9	88.7	67.6	78.6	91.4	85.4	75.5	38.2	42.4
05/24/93	11:54	1219.23	71.4	80.2	79.6	69.7	88.9	80.7	78.0	85.6	87.1	67.8	79.5	89.2	86.1	70.5	39.4	42.8
05/24/93	19:10	1226.50	71.0	79.8	81.1	70.4	88.8	81.0	77.4	85.8	86.1	67.6	79.7	89.4	86.2	70.1	39.6	42.9
05/25/93	21:30	1252.83	69.1	77.0	82.4	68.1	87.1	80.5	75.9	85.4	82.6	67.7	78.8	88.1	83.8	72.5	40.5	43.6
05/26/93	19:20	1274.67	66.5	74.3	83.4	64.6	85.4	79.3	74.0	83.7	80.0	66.6	77.6	86.8	82.9	71.3	40.4	43.6
05/27/93	09:12	1288.53	65.6	73.7	84.5	63.1	84.6	77.9	73.7	80.2	78.7	66.7	77.3	85.9	82.6	67.6	40.7	44.1
05/28/93	09:19	1312.65	63.7	72.8	89.3	60.9	83.7	77.5	72.7	82.5	77.6	66.1	76.4	85.1	81.8	71.2	41.2	44.4
05/29/93	05:48	1333.13	62.6	71.4	93.8	60.9	81.9	77.3	72.1	81.8	76.7	65.6	76.3	83.3	83.1	79.0	41.5	44.5
05/30/93	09:30	1360.83	61.8	70.8	98.7	60.8	81.3	77.0	71.3	81.4	75.9	65.0	75.6	83.1	83.3	73.4	41.7	44.9
05/31/93	11:40	1387.00	62.0	70.3	103.0	61.5	80.3	76.1	70.5	80.7	76.4	64.2	74.6	82.2	83.1	77.4	41.6	44.8
06/01/93	09:25	1408.75	61.2	70.8	106.0	61.1	79.7	75.3	70.1	80.3	76.4	64.1	74.3	81.8	82.0	67.8	41.8	45.0
06/02/93	08:00	1431.33	62.9	72.2	110.2	63.3	78.8	77.3	70.0	80.5	78.1	63.8	74.0	81.3	82.7	70.5	42.2	45.3
06/03/93	09:27	1456.78	62.7	73.0	112.0	63.0	78.0	77.3	69.8	80.5	81.0	63.7	73.4	80.7	83.5	73	42.1	45.4
06/03/93	12:00	1459.33	62.4	73	112.1	62.5	77.4	76.3	69.2	79.8	80.3	63	72.9	80.2	81.2	72.6	41.7	44.8

Table B-1 Ground Electrodes and Outside Thermowell (TW7) Temperature (Recorded Manually) [Continued]

Date	Time	Elapsed Time	A4C 24-ft	C1C 24-ft	C2C 24-ft	C3C 24-ft	C4C 24-ft	A3D 29-ft	A4D 29-ft	C2D 29-ft	C3D 29-ft	C4D 29-ft	C6D 29-ft	TW7B 12-ft	TW7C 24-ft	TW7D 29-ft
Maximum Temp. --->			49	42	49	52	49	32	34	32	33	32	30	62	39	28
04/03/93	16:40	0.00														
04/03/93	17:00	0.33	21.9	21.5	21.6	21.7	21.8	21.9	21.9	21.9	21.9	21.8	21.9			
04/04/93	17:10	24.50	21.9	21.4	21.5	21.6	21.6	21.9	21.9	21.8	21.8	21.6	21.8			
04/05/93	19:00	50.33	21.8	21.5	21.4	21.4	21.5	21.7	21.7	21.7	21.6	21.5	21.7			
04/06/93	17:30	72.83	22.3	21.6	21.6	21.8	21.8	21.9	21.9	21.9	21.9	21.8	21.9			
04/07/93	22:10	101.50	22.2	21.5	21.4	21.6	21.7	21.8	21.8	21.7	21.7	21.6	21.8			
04/08/93	21:20	124.67	22.2	21.6	21.6	21.6	21.7	21.8	21.8	21.8	21.6	21.5	21.6			
04/09/93	21:40	149.00	22.4	21.6	21.6	21.7	21.8	21.8	21.8	21.7	21.7	21.5	21.6			
04/10/93	17:45	169.08	22.7	21.5	21.7	21.8	22.0	21.8	21.8	21.6	21.6	21.4	21.6			
04/11/93	18:10	193.50	23.0	21.7	21.9	22.1	22.5	21.9	21.8	21.7	21.6	21.5	21.7	20.1	21.6	21.6
04/12/93	18:51	218.18	23.3	21.8	22.2	22.4	22.8	21.8	21.8	21.7	21.6	21.6	21.7	20.7	21.6	21.4
04/13/93	03:45	227.08	23.4	21.9	22.4	22.8	23.2	21.8	22.0	21.9	21.9	21.8	21.9	21.1	22.0	21.6
04/14/93	05:55	253.25	23.8	22.0	22.8	23.2	23.6	21.9	22.1	21.9	22.0	21.9	21.9	22.0	22.1	21.7
04/15/93	07:00	278.33	24.0	22.1	22.8	23.4	24.0	21.9	22.1	21.9	21.9	21.8	21.8	23.0	22.1	21.6
04/16/93	08:45	304.08	24.8	22.3	23.4	24.2	24.7	22.1	22.2	22.2	22.2	21.9	21.8	24.2	22.7	21.8
04/17/93	08:29	327.82	24.8	22.3	23.3	24.2	24.7	22.0	22.1	22.0	22.0	21.8	21.6	25.5	22.4	21.5
04/18/93	07:48	351.13	25.1	22.5	23.5	24.5	25.2	22.1	22.3	22.1	22.1	22.0	21.9	27.0	22.6	21.6
04/19/93	06:40	374.00	25.4	22.8	23.9	24.9	25.8	22.2	22.4	22.0	22.1	22.1	22.1	28.6	22.8	21.7
04/20/93	08:46	400.10	25.7	22.9	24.2	25.3	26.3	22.2	22.5	22.1	22.3	22.2	22.1	30.4	23.1	21.9
04/21/93	09:00	424.33	26.2	23.3	24.8	26.1	27.0	22.3	22.6	22.3	22.4	22.2	22.1	32.4	23.5	21.8
04/22/93	09:18	448.63	26.7	23.4	25.2	26.8	28.0	22.5	22.7	22.4	22.6	22.3	22.1	34.2	23.7	21.9
04/23/93	08:00	471.33	27.1	23.8	25.8	27.4	28.7	22.6	22.9	22.5	22.7	22.5	22.3	36.2	24.0	21.9
04/24/93	09:15	496.58	27.4	24.0	26.0	27.9	29.6	22.6	22.9	22.3	22.6	22.4	22.6	38.0	24.3	22.1
04/25/93	06:42	518.03	27.8	24.3	26.3	28.4	30.2	22.7	23.1	22.6	22.8	22.8	22.7	39.8	24.6	22.2
04/26/93	07:15	542.58	28.4	24.8	27.1	29.4	31.6	22.9	23.2	22.7	23.1	23.1	22.9	41.8	25.1	22.1
04/27/93	11:05	570.42	29.1	25.0	27.7	30.3	32.9	22.9	23.4	22.7	23.1	23.1	22.9	43.7	25.7	22.2
04/28/93	08:00	591.33	29.6	25.5	28.3	31.3	34.0	23.0	23.4	22.9	23.3	23.3	23.1	45.4	26.1	22.2
04/29/93	08:20	615.67	30.0	26.1	29.2	32.6	35.2	23.1	23.6	23.0	23.3	23.5	23.4	47.1	26.6	22.1
04/30/93	09:00	640.33	30.7	26.4	30.6	33.7	36.5	23.1	23.7	23.3	23.8	23.5	23.1	48.8	28.3	22.4
05/01/93	11:36	666.93	31.1	26.8	31.4	34.3	37.1	23.2	23.8	23.3	23.9	23.8	23.5	49.6	28.6	22.4
05/02/93	09:20	688.67	31.9	27.7	31.6	35.2	37.7	23.7	24.3	23.9	24.5	24.3	23.8	50.6	28.8	22.7
05/03/93	12:21	715.68	32.1	27.7	31.8	35.1	37.0	23.6	24.3	23.8	24.5	24.4	23.9	50.5	29.2	22.7
05/04/93	15:59	743.32	32.7	28.6	32.6	35.6	37.2	24.2	24.9	24.4	25.0	25.1	24.7	51.4	29.9	23.3
05/05/93	07:09	758.48	33.0	28.8	32.9	35.7	37.1	24.2	25.0	24.5	25.1	25.2	25.0	52.2	29.8	23.4
05/06/93	08:12	783.53	33.6	29.4	34.1	36.0	37.2	24.5	25.3	24.8	25.4	25.5	25.3	53.1	30.3	23.5
05/07/93	21:05	820.42	34.1	30.0	36.9	36.2	37.3	24.8	25.6	25.0	25.6	25.7	25.7	54.3	30.3	23.7
05/08/93	18:12	841.53	34.3	30.2	36.4	36.3	37.2	24.8	25.7	25.2	25.7	25.7	25.8	54.6	30.3	23.6
05/09/93	06:04	853.40	34.9	30.4	36.6	36.1	37.6	25.0	25.9	25.3	25.7	25.9	26.0	55.1	30.7	23.9
05/10/93	10:11	881.52	35.7	30.6	35.9	37.3	37.9	25.0	25.9	25.4	26.1	25.9	25.9	55.7	30.8	23.8
05/10/93	?	893.30	35.8	30.9	35.7	37.0	37.9	25.1	[illegible]	25.4	25.9	25.8	26.2	56.2	30.5	23.6

Table B-1 Ground Electrodes and Outside Thermowell (TW7) Temperature (Recorded Manually) [Continued]

Date	Time	Elapsed Time	A4C 24-ft	C1C 24-ft	C2C 24-ft	C3C 24-ft	C4C 24-ft	A3D 29-ft	A4D 29-ft	C2D 29-ft	C3D 29-ft	C4D 29-ft	C6D 29-ft	TW7B 12-ft	TW7C 24-ft	TW7D 29-ft
Maximum Temp. --->			49	42	49	52	49	32	34	32	33	32	30	62	39	28
05/11/93	09:14	904.57	36.6	31.0	36.2	37.8	38.5	25.2	26.1	25.7	26.4	26.0	25.9	56.3	31.1	24.0
05/12/93	12:24	931.73	36.8	30.9	35.6	37.9	38.8	25.5	26.4	25.7	26.3	26.4	26.3	56.8	31.2	24.1
05/13/93	09:30	952.83	37.8	31.6	36.4	38.8	39.6	25.6	26.6	26.0	26.7	26.4	26.4	57.5	31.6	24.2
05/14/93	04:00	971.33	38.4	32.2	36.7	39.0	40.2	26.1	27.2	26.3	26.8	26.9	27.2	58.2	31.8	24.3
05/15/93	09:21	1000.68	39.6	32.3	37.0	39.9	41.0	26.2	27.4	26.5	27.2	26.9	27.0	58.7	32.0	24.4
05/16/93	15:43	1031.05	40.9	32.7	37.4	40.9	42.2	26.3	27.7	26.3	27.2	27.2	27.5	59.6	32.6	24.6
05/17/93	23:27	1062.78	42.8	33.9	38.7	42.9	44.5	26.9	28.4	26.9	27.8	28.0	28.3	61.0	33.4	25.2
05/18/93	09:50	1073.17	43.3	33.8	39.3	43.4	45.1	27.1	28.5	27.2	28.1	28.1	28.1	61.0	33.7	25.2
05/19/93	01:53	1089.22	43.8	34.5	39.6	44.1	46.0	27.4	28.7	27.2	28.1	28.3	28.2	61.6	33.8	25.2
05/19/93	23:58	1111.30	44.7	35.1	40.6	45.1	46.9	27.6	29.1	27.5	28.4	28.5	28.2	61.8	34.3	25.2
05/20/93	23:24	1134.73	45.0	35.5	41.2	46.0	47.4	27.9	29.5	27.8	28.7	28.9	28.4	61.8	34.9	25.4
05/22/93	22:00	1181.33	46.1	36.6	42.9	47.4	48.4	28.6	30.3	28.4	29.4	29.6	28.9	62.0	37.8	26.0
05/23/93	10:48	1194.13	46.6	37.1	43.1	47.9	48.6	28.7	30.3	28.5	29.6	29.7	28.9	61.7	37.5	26.0
05/24/93	11:54	1219.23	47.1	37.7	45.8	48.9	48.8	28.8	30.6	28.6	29.8	29.8	28.9	61.1	37.4	26.3
05/24/93	19:10	1226.50	47.1	37.8	47.4	49.1	48.9	29.1	30.8	28.9	29.9	30.0	29.3	61.0	37.2	26.4
05/25/93	21:30	1252.83	47.4	38.8	48.0	50.3	49.0	29.5	31.3	29.3	30.4	30.4	29.6	60.8	37.3	26.5
05/26/93	19:20	1274.67	47.3	39.1	48.1	50.6	48.9	29.6	31.3	29.4	30.5	30.4	29.5	60.2	37.2	26.5
05/27/93	09:12	1288.53	47.8	39.8	48.5	51.3	49.0	29.8	31.6	29.8	30.8	30.5	29.3	60.0	37.6	26.6
05/28/93	09:19	1312.65	48.0	40.4	48.4	51.6	49.1	30.2	32.0	30.2	31.2	30.7	29.6	59.7	37.8	26.8
05/29/93	05:48	1333.13	48.0	41.2	48.3	51.6	49.1	30.5	32.3	30.4	31.4	31.0	30.2	59.6	37.8	26.8
05/30/93	09:30	1360.83	48.4	41.8	48.3	51.9	49.3	30.8	32.8	30.8	31.9	31.3	30.2	59.4	38.4	27.2
05/31/93	11:40	1387.00	48.2	41.9	48.1	51.3	48.8	31.1	32.9	31.0	32.0	31.4	30.2	58.4	38.3	27.1
06/01/93	09:25	1408.75	48.2	42.2	48.2	51.2	48.6	31.3	33.1	31.2	32.1	31.2	29.9	58.4	38.3	27.2
06/02/93	08:00	1431.33	48.4	42.4	48.4	51.1	48.8	31.8	33.7	31.7	32.5	31.8	30.4	58.7	38.7	27.7
06/03/93	09:27	1456.78	48.6	42.3	48.3	51.1	48.8	32.2	33.9	32.2	33	32	30.3	58.3	38.9	28.1
06/03/93	12:00	1459.33	48.1	41.8	47.6	50.4	48.2	31.9	33.8	31.8	32.7	31.7	30.2	58	38.5	27.5

Table B-1 Ground Electrodes and Outside Thermowell (TW7) Temperature (Recorded Manually) [Continued]

Date	Time	Elapsed Time	Average Temperatures 1-foot	12-foot	24-foot	Opposite Excitors, All	Grand Average
Maximum Temp. --->			87	88	47	77	72
04/03/93	16:40	0.00					
04/03/93	17:00	0.33	18.3	19.7	21.7	20.1	20.0
04/04/93	17:10	24.50	21.3	19.6	21.7	21.2	20.8
04/05/93	19:00	50.33	27.6	19.7	21.6	23.5	22.6
04/06/93	17:30	72.83	32.4	20.0	21.9	25.5	24.2
04/07/93	22:10	101.50	38.3	20.6	21.8	27.8	26.1
04/08/93	21:20	124.67	42.9	21.6	21.9	29.9	27.8
04/09/93	21:40	149.00	46.5	23.1	22.0	32.1	29.4
04/10/93	17:45	169.08	48.8	24.7	22.1	33.8	30.7
04/11/93	18:10	193.50	51.2	27.2	22.4	36.0	32.5
04/12/93	18:51	218.18	53.7	29.8	22.6	38.3	34.2
04/13/93	03:45	227.08	54.7	30.9	22.8	39.3	35.0
04/14/93	05:55	253.25	56.7	34.0	23.1	41.6	36.8
04/15/93	07:00	278.33	58.1	37.3	23.3	43.8	38.6
04/16/93	08:45	304.08	58.5	40.9	23.8	45.8	40.2
04/17/93	08:29	327.82	57.5	44.2	23.8	42.4	40.4
04/18/93	07:48	351.13	58.6	47.2	24.2	48.9	43.7
04/19/93	06:40	374.00	60.2	50.4	24.5	51.0	44.6
04/20/93	08:46	400.10	61.6	53.8	24.7	53.1	46.3
04/21/93	09:00	424.33	62.1	56.7	25.2	54.5	47.7
04/22/93	09:18	448.63	62.6	59.3	25.7	56.0	49.1
04/23/93	08:00	471.33	64.2	61.6	26.2	57.6	50.5
04/24/93	09:15	496.58	65.6	64.4	26.6	59.4	52.2
04/25/93	06:42	518.03	67.4	66.3	27.0	60.7	53.5
04/26/93	07:15	542.58	70.4	68.6	27.7	62.8	55.5
04/27/93	11:05	570.42	73.2	71.2	28.4	65.1	57.5
04/28/93	08:00	591.33	76.8	73.1	29.0	67.3	59.4
04/29/93	08:20	615.67	79.7	75.8	29.8	69.7	61.6
04/30/93	09:00	640.33	77.7	75.7	30.5	68.4	61.2
05/01/93	11:36	666.93	75.1	75.5	31.1	66.9	60.6
05/02/93	09:20	688.67	71.6	74.9	31.8	59.4	58.8
05/03/93	12:21	715.68	74.7	76.0	31.7	67.1	60.9
05/04/93	15:59	743.32	79.4	78.6	32.4	70.1	63.4
05/05/93	07:09	758.48	81.2	79.9	32.6	71.1	64.5
05/06/93	08:12	783.53	81.7	80.5	33.1	71.1	65.0
05/07/93	21:05	820.42	82.4	82.0	33.8	71.8	66.1
05/08/93	18:12	841.53	81.4	81.4	33.9	70.8	65.5
05/09/93	06:04	853.40	82.7	82.7	34.1	71.9	66.5
05/10/93	10:11	881.52	84.3	83.1	34.5	72.4	67.2
05/10/93	[illegible]	893.30	85.1	83.4	34.6	72.9	67.6

Table B-1 Ground Electrodes and Outside Thermowell (TW7) Temperature (Recorded Manually) [Continued]

Date	Time	Elapsed Time	Average Temperatures 1-foot	12-foot	24-foot	Opposite Excitors, All	Grand Average
Maximum Temp. --->			87	88	47	77	72
05/11/93	09:14	904.57	85.2	83.8	35.0	73.1	68.0
05/12/93	12:24	931.73	81.5	82.6	35.1	71.4	66.4
05/13/93	09:30	952.83	84.4	84.9	35.9	73.7	68.4
05/14/93	04:00	971.33	84.4	84.0	36.4	73.0	68.2
05/15/93	09:21	1000.68	85.3	85.0	37.0	74.1	69.1
05/16/93	15:43	1031.05	85.7	86.4	37.9	75.3	70.0
05/17/93	23:27	1062.78	86.8	87.7	39.5	76.7	71.4
05/18/93	09:50	1073.17	86.7	88.2	39.9	77.2	71.7
05/19/93	01:53	1089.22	84.6	86.5	40.5	75.5	70.6
05/19/93	23:58	1111.30	82.8	84.5	41.4	74.4	69.6
05/20/93	23:24	1134.73	80.3	82.3	41.9	72.8	68.2
05/22/93	22:00	1181.33	78.5	82.5	43.2	73.1	68.2
05/23/93	10:48	1194.13	78.9	81.7	43.4	72.9	68.1
05/24/93	11:54	1219.23	78.4	80.5	44.4	72.0	67.8
05/24/93	19:10	1226.50	78.7	80.3	44.7	72.0	68.0
05/25/93	21:30	1252.83	77.4	79.4	45.4	71.5	67.5
05/26/93	19:20	1274.67	75.6	77.9	45.4	70.6	66.4
05/27/93	09:12	1288.53	74.9	76.6	45.9	69.8	65.9
05/28/93	09:19	1312.65	74.7	76.7	46.2	70.4	65.9
05/29/93	05:48	1333.13	74.7	77.2	46.3	70.9	66.2
05/30/93	09:30	1360.83	75.1	76.1	46.6	70.7	66.0
05/31/93	11:40	1387.00	75.5	76.1	46.4	71.0	66.0
06/01/93	09:25	1408.75	75.7	74.6	46.5	70.2	65.5
06/02/93	08:00	1431.33	77.5	75.1	46.7	71.2	66.3
06/03/93	09:27	1456.78	77.7	75.7	46.7	71.8	66.8
06/03/93	12:00	1459.33	77.3	74.9	46.1	71.1	66.0

Table B-2 Temperature in Thermowells (Outside Thermowell TW7 in Table B-1)

Date	Time	Elapsed Time	TW1A 1-ft	TW2A 1-ft	TW3A 1-ft	TW4A 1-ft	TW5A 1-ft	TW6A 1-ft	TW7A 1-ft	TW1B 12-ft	TW2B 12-ft	TW3B 12-ft	TW4B 12-ft	TW5B 12-ft	TW6B 12-ft	TW7B 12-ft	TW1-20 20-ft	TW2-20 20-ft	TW3-20 20-ft
Maximum Temp. --->			103.1	129	104.7	195.1	243	180.6	ERR	93.7	126	110.6	167.5	201.3	206.2	ERR	68.8	117.4	87.4
04/03/93	16:40	0.00																	
04/03/93	20:05	3.42																	
04/03/93	20:45	4.08																	
04/03/93	19:00	2.33	17.9					17.9		18.9					18.6				
04/04/93	16:00	23.33	34.7	36.4	24.7	25.7	29.4	24.8		19.2	19.1	19.1			19.6				
04/05/93	19:30	50.83	72.0	75.0	47.0	50.0	66.0	45.0		19.0									
04/06/93	16:00	71.33	79.0	85.0	59.0	65.0	77.0	62.0		19.0	21.0	20.0	22.0	24.0	25.0				
04/07/93	19:00	98.33	81.0	85.0	67.0	76.0	81.0	72.0		20.0	30.0	22.0	30.0	42.0	41.0				
04/08/93	19:15	122.58	83.1	87.6	71.6	82.8	88.2	81.7		20.6	32.3	25.6	36.5	57.2	58.6				
04/09/93	20:00	147.33	82.6	89.3	74.1	88.5	95.9	90.6		21.9	36.8	28.8	44.1	72.3	79.2				
04/10/93	19:55	171.25	82.1	90.9	76.8	93.5	95.5	95.6		23.6	41.5	32.5	52.5	84.5	88.6				
04/12/93	20:45	220.08	78.4	91.7	78.8	96.5	96.5	97.0		27.0	48.2	39.5	65.8	91.1	93.7				
04/13/93	20:00	243.33	78.5	93.8	82.3	96.4	101.1	97.0		28.6	52.2	43.0	71.8	92.3	95.1				
04/14/93	20:25	267.75	78.0	94.7	85.9	96.7	102.9	97.2		30.4	55.8	47.3	78.0	92.8	95.4				
04/15/93	21:00	292.33	77.0	97.8	90.0	98.0	113.6	98.3		33.4	61.0	52.2	85.5	98.0	98.4				
04/16/93	14:45	310.08	77.2	99.7	92.6	98.5	116.7	98.7		35.1	65.0	55.9	98.4	99.3	99.6				
04/17/93	23:20	342.67	73.9	99.8	98.8	97.8	120.8	103.0		38.1	69.8	61.5	97.9	98.7	99.7				
04/18/93	19:14	362.57	74.5	101.6	95.1	98.7	126.8	107.4		40.3	73.6	65.2	98.4	99.5	101.9				
04/19/93	18:40	386.00	76.2	104.3	96.3	99.5	131.1	110.4		43.0	81.5	69.6	98.4	100.2	102.7				
04/20/93	18:50	410.17	77.5	105.9	96.4	101.0	135.2	110.4		45.8	96.8	73.4	98.3	101.1	103.4				
04/21/93	18:53	434.22	75.8	104.9	92.1	102.3	136.3	108.6		48.6	87.3	75.8	98.4	101.6	103.4				
04/22/93	19:14	458.57	76.2	106.0	92.0	103.8	137.3	116.4		51.6	90.7	78.9	98.3	99.6	104.1				
04/23/93	21:25	484.75	78.3	108.6	95.1	108.7	139.5	121.7		54.6	97.3	87.6	97.8	99.0	104.9				
04/24/93	20:00	507.33	80.6	110.9	96.5	108.1	140.5	124.5		57.1	97.6	97.2	97.9	100.4	100.1				
04/25/93	20:50	532.17	81.5	111.9	96.6	110.8	145.6	126.9		59.6	97.9	98.1	98.3	107.6	100.2				
04/26/93	20:30	555.83	84.3	114.7	97.0	112.9	147.6	129.4		62.2	97.7	97.9	98.2	108.7	101.7				
04/27/93	20:55	580.25	88.4	118.0	98.1	127.8	149.7	132.4		66.1	99.2	99.7	115.8	111.6	111.3				
04/28/93	18:35	601.92	89.7	118.3	97.1	117.6	153.1	134.4		67.2	97.8	98.1	98.3	111.3	111.1				
04/29/93	18:35	625.92	90.6	115.4	93.0	120.5	153.4	135.3		70.0	93.5	93.8	97.8	110.7	111.8				
04/30/93	20:00	651.33	83.3	105.5	92.3	122.7	156.7	135.7		70.2	93.4	93.2	96.6	109.5	111.5				
05/01/93	20:30	675.83	82.2	111.9	92.1	123.2	158.8	135.7		72.2	92.3	92.1	95.6	108.6	110.7				
05/02/93	20:35	699.92	77.3	107.4	88.8	120.7	158.1	132.4		69.8	92.3	90.7	94.2	106.7	108.4				
05/03/93	20:40	724.00	82.8	111.6	93.6	125.5	159.9	136.8		72.2	95.6	94.1	97.5	111.2	112.3				
05/04/93	19:08	746.47	85.9	114.6	96.0	128.7	161.5	139.9		74.8	96.7	95.8	100.2	114.6	115.5				
05/05/93	22:30	773.83	82.9	115.7	92.3	130.7	154.7	139.9		76.1	96.1	95.3	101.5	117.3	108.9				
05/06/93	21:00	796.33	85.0	99.0	98.0	132.0	164.0	121.0		79.0	98.0	96.0	107.0	120.0	106.0				
05/07/93	21:44	821.07	91.0	100.0	99.0	134.0	161.0	126.0		81.0	99.0	97.0	111.0	126.0	124.0				
05/08/93	20:04	843.40	91.9	98.9	99.4	140.2	155.5	120.0		81.4	99.4	96.8	114.4	126.9	126.8				
05/09/93	21:07	868.45	96.0	99.5	99.6	136.1				83.2	99.6	98.6	120.2						
05/10/93		891.75	101.4	102.2	102.9	141.2	165.1	152.0		87.8	103.0	101.7	127.3	138.8	137.2				

Table B-2 Temperature in Thermowells (Outside Thermowell TW7 in Table B-1) [Continued]

Date	Time	Elapsed Time	TW1A 1-ft	TW2A 1-ft	TW3A 1-ft	TW4A 1-ft	TW5A 1-ft	TW6A 1-ft	TW7A 1-ft	TW1B 12-ft	TW2B 12-ft	TW3B 12-ft	TW4B 12-ft	TW5B 12-ft	TW6B 12-ft	TW7B 12-ft	TW1-20 20-ft	TW2-20 20-ft	TW3-20 20-ft
Maximum Temp. --->			103.1	129	104.7	195.1	243	180.6	ERR	93.7	126	110.6	167.5	201.3	206.2	ERR	68.8	117.4	87.4
05/11/93	20:10	915.50	103.1	104.0	103.8	141.4	166.4	152.4		89.4	104.8	102.2	131.7	143.4	141.4				
05/12/93	20:00	939.33	100.0	104.4	104.1	139.2	164.0	151.4		89.5	104.3	103.7	133.4	145.5	143.2				
05/13/93	20:17	963.62	102.1	119.8	104.3	141.0	164.2	151.9		91.3	106.2	105.1	137.0	150.2	147.5				
05/14/93	20:20	987.67	101.7	128.2	104.7	141.6	164.0	151.0		92.3	105.9	104.6	139.1	154.2	151.4				
05/15/93	21:00	1012.33	102.9	129.0	104.4	142.4	163.4	150.0		93.7	115.7	104.9	140.9	158.6	155.9				
05/16/93	20:50	1036.17	98.8	125.9	100.0	138.6	158.0	147.3		90.3	112.8	100.5	137.4	156.8	154.2				
05/17/93	20:22	1059.70	98.1	126.2	99.5	139.6	158.7	148.0		90.6	113.7	101.6	133.0	158.6	155.5		54.2	82.5	76
05/18/93	21:30	1084.83	96.5	125.4	99.6	138.1	158.2	147.6		90.1	113.9	103.7	130.7	159.3	156.5		55.1	82.4	76.6
05/19/93	20:00	1107.33	91.1	121.9	99.8	135.0	155.2	145.4		89.9	115.4	110.6	126.1	160.8	157.9		56.7	88.2	79.2
05/20/93	22:05	1133.42	83.0	115.1	95.2	125.5	148.4	140.3		86.1	114.6	98.7	140.4	161.6	158.9		56.4	85	78
05/21/93	21:10	1156.50	78.4	109.9	90.0	122.8	144.3	137.8		84.6	114.6	99.7	142.6	168.8	165.6		56.8	79.8	75.6
05/22/93	12:55	1172.25	77.4		88.2	121.3		136.7		85.6		98.6	143.5		171.1		57.8		71.6
05/23/93	21:25	1204.75	68.2	112.2	84.0	125.6	153.6	111.5		85.7	99.5	98.8	146.6	187.4	184.0		64.4	110.7	85.1
05/24/93	08:00	1215.33	72.1	97.9	86.6	126.0	140.5	138.9		86.4	105.4	99.4	146.2	194.0	189.8		59.2	92.3	84.4
05/24/93	20:10	1227.50	71.1	100.3	89.5	129.6	157.6	126.9		86.2	115.4	100.6	152.0	201.3	195.3		63.2	117.4	86.1
05/25/93	19:00	1250.33	70.4	102.1	90.9	134.7	151.9	146.7		85.7	122.4	101.9	157.9		199.9		65.4	101.5	86.9
05/26/93	20:25	1275.75	70.3	102.3	93.0	141.8	140.8	140.5		85.7	126.0	103.7	165.9		206.2		68.8	109.4	87.4
05/27/93	12:11	1291.52	64.7	100.8	87.6	157.5	145.1	148.0		81.9	124.8	101.0	150.6		201.2		61.4	102.3	85.7
05/28/93	03:00	1306.33	64.0	103.0	87.7	144.1	152.6	151.0		82.0		101.0	160.0		202.0				
05/28/93	20:20	1323.67	64.7	101.2	91.6	178.6	129.0	156.5		81.3	125.3	101.0	167.5		203.0				
05/29/93	03:30	1330.83					139.4	160.5							204.0				
05/29/93	15:00	1342.33					173.0	162.9							203.3				
05/29/93	19:50	1347.17	62.4	101.6	93.8	193.3	175.9	165.8		80.3	124.3	101.8							
05/30/93	19:28	1370.80	62.3	101.4	96.6	195.1	191.0	174.9		80.3	123.9	101.5							
05/31/93	19:30	1394.83	63.7	103.1	98.5	175.4	243.0	180.1		78.8	121.1	100.6			203.1				
06/01/93	03:40	1403.00	64.4	102.5	97.5	170.6	237.8	180.6		79.3	120.4	100.4			203.1				
06/01/93	19:00	1418.33	65.0	107.5	96.3	166.9	227.1	180.0		78.2	118.8	99.4			202.4				
06/02/93	19:00	1442.33	68.3	102.6	96.3	162.8	216.6	178.6		77.5	116.8	98.3			201.9				
06/03/93	12:30	1459.83	69.6	101.1	95.1	156.8	214.0	176.8		76.3	115.5	96.4			200.3				

Table B-2 Temperature in Thermowells (Outside Thermowell TW7 in Table B-1) [Continued]

Date	Time	Elapsed Time	TW4-20 20-ft	TW5-20 20-ft	TW6-20 20-ft	TW1C 24-ft	TW2C 24-ft	TW3C 24-ft	TW4C 24-ft	TW5C 24-ft	TW6C 24-ft	Average Temperatures 1-Foot	12-Foot	20-foot	24-Foot	TW7C 24-ft	TW1D 29-ft	TW2D 29-ft
Maximum Temp. --->			196.5	233.7	204.6	63.3	60.4	90.2	90.1	68	65.4	144	142	133	59	ERR	37.5	37.6
04/03/93	16:40	0.00																
04/03/93	20:05	3.42																
04/03/93	20:45	4.08																
04/03/93	19:00	2.33				20.9												
04/04/93	16:00	23.33										29	19					
04/05/93	19:30	50.83										59	19					
04/06/93	16:00	71.33										71	22					
04/07/93	19:00	98.33										77	31					
04/08/93	19:15	122.58									21.6	83	38		22			
04/09/93	20:00	147.33									22.3	87	47		22			
04/10/93	19:55	171.25							22.8		23.2	89	54		23			
04/12/93	20:45	220.08										90	61					
04/13/93	20:00	243.33				21.8	23.5	22.7	24.1	26.1	25.0	92	64		24			
04/14/93	20:25	267.75						22.7	24.6		25.3	93	67		24			
04/15/93	21:00	292.33						23.7	25.6		26.5	96	71		25			
04/16/93	14:45	310.08				22.8	24.4	24.1	26.2	28.2	27.3	97	76		26			
04/17/93	23:20	342.67				22.8	24.5	24.1	26.5	28.7	27.6	99	78		26			
04/18/93	19:14	362.57				23.1	25.4	24.9	27.6	29.4	28.7	101	80		27			
04/19/93	16:40	386.00				23.6	26.0	25.4	28.4	30.2	29.5	103	83		27			
04/20/93	18:50	410.17				23.5	26.0	25.6	28.7	30.6	30.0	104	86		27		21.6	21.9
04/21/93	16:53	434.22				23.7	26.8	26.0	29.8	31.3	31.0	103	86		28			
04/22/93	19:14	458.57				24.0	27.3	26.7	30.8	32.2	32.3	105	87		29			
04/23/93	21:25	484.75				24.4	27.8	27.4	31.7	33.1	33.5	109	90		30		21.6	22.0
04/24/93	20:00	507.33				24.8	28.6	29.7	32.9	34.5	34.6	110	92		31		21.7	22.1
04/25/93	20:50	532.17				26.6	29.6	29.0	34.3	35.8	36.3	112	94		32		22.0	22.4
04/26/93	20:30	555.83				25.6	30.2	29.7	35.5	36.5	37.3	114	94		32		21.9	22.3
04/27/93	20:55	580.25				27.0	32.0	31.3		38.2	39.6	119	101		34			
04/28/93	18:35	601.92				26.8	31.6	31.5	38.4	38.3	40.1	118	97		34		22.7	22.9
04/29/93	18:35	625.92				27.6	31.9	31.9	39.0	38.6	41.1	118	96		35			22.3
04/30/93	20:00	651.33				27.4	32.5	33.0	39.7	39.1	41.9	116	96		36		21.7	22.3
05/01/93	20:30	675.83				28.6	33.3	33.9	41.0	40.2	42.5	117	95		37		22.6	22.8
05/02/93	20:35	699.92				28.0	33.6	33.9	40.8	40.4	42.5	114	94		37		21.9	23.0
05/03/93	20:40	724.00				28.8	34.0	34.3	41.2	40.6	42.3	118	97		37		22.5	23.6
05/04/93	19:08	746.47				29.3	34.3	35.6	40.9	41.1	42.1	121	100		37		23.2	23.9
05/05/93	22:30	773.83				28.6	34.0	34.7	40.6	42.0	42.0	119	99		37		22.2	23.4
05/06/93	21:00	796.33				30.0	35.0	36.0	41.0	44.0	43.0	117	101		38		23.0	25.0
05/07/93	21:44	821.07				30.0	37.0	36.0	42.0	46.0	43.0	119	106		39		24.0	26.0
05/08/93	20:04	843.40				31.1	36.7	37.2	42.6	46.4	44.3	118	108		40		24.0	25.5
05/09/93	21:07	868.45				31.7	37.7	37.8	43.3			108	100		38		27.1	29.1
05/10/93	[illegible]	891.75				34.3	40.4	40.5		52.1	48.2	127	116		44		[illegible]	[illegible]

Table B-2 Temperature in Thermowells (Outside Thermowell TW7 in Table B-1) [Continued]

Date	Time	Elapsed Time	TW4-20 20-ft	TW5-20 20-ft	TW6-20 20-ft	TW1C 24-ft	TW2C 24-ft	TW3C 24-ft	TW4C 24-ft	TW5C 24-ft	TW6C 24-ft	Average Temperatures 1-Foot	12-Foot	20-foot	24-Foot	TW7C 24-ft	TW1D 29-ft	TW2D 29-ft
Maximum Temp. --->			196.5	233.7	204.6	63.3	60.4	90.2	90.1	68	65.4	144	142	133	59	ERR	37.5	37.6
05/11/93	20:10	915.50				36.0	42.6	42.3	48.4	55.0	50.3	129	119		46		28.2	29.5
05/12/93	20:00	939.33				36.7	43.5	42.8	49.3	56.2	51.5	127	120		47		28.3	30.0
05/13/93	20:17	963.62				37.3	44.6	44.1	50.7	58.4	53.0	131	123		48		28.9	30.4
05/14/93	20:20	987.67				38.4	45.9	45.3	52.2	60.2	54.7	132	125		49		29.6	31.0
05/15/93	21:00	1012.33				39.0	46.8	46.2	54.4	62.0	56.9	132	128		51		29.7	
05/16/93	20:50	1036.17				36.0	44.7	43.3	52.4	61.4	55.0	128	125		49		28.3	32.8
05/17/93	20:22	1059.70	96.7	104	91.6	36.3	46.6	44.3	54.4	63.7	57.4	128	126	84	51			
05/18/93	21:30	1084.83	90.6	129.7	103.6	37.7	47.4	45.8	56.7	66.1	59.7	128	126	90	52			
05/19/93	20:00	1107.33	97.8	137.4	113.8	38.4	48.4	47.1	58.4	68.0	61.9	125	127	96	54		29.4	37.3
05/20/93	22:05	1133.42	93.5	163.4	119.5	37.9	48.3		58.0	66.8	61.4	118	127	99	54		29.9	37.6
05/21/93	21:10	1156.50	95.9	176.1	128.3	38.2	48.8	47.7	58.8	66.7	62.0	114	129	102	54			
05/22/93	12:55	1172.25	89.7		90.2	38.8		47.1	59.0		62.5	106	125		52			
05/23/93	21:25	1204.75	126.4	233.7	175.7	39.4	51.6	50.0	62.6	66.9	63.3	109	134	133	56			
05/24/93	08:00	1215.33	147.2	201.6	148.7	40.0	53.3	50.2	63.3	67.6	63.5	110	137	122	56			
05/24/93	20:10	1227.50	148.7		165.7	41.9	56.1	52.8	65.6		65.4	113	142	116	56			
05/25/93	19:00	1250.33	186.2			44.2	50.2	56.3	68.5			116	134	110	55			
05/26/93	20:25	1275.75	196.5		204.6	46.1	60.4	58.5	69.6			115	138	133	59			
05/27/93	12:11	1291.52				44.3	54.5	56.6				117	132					
05/28/93	03:00	1306.33										117						
05/28/93	20:20	1323.67				63.3	59.5	57.3	85.0			120	136				29.6	32.5
05/29/93	03:30	1330.83																
05/29/93	15:00	1342.33																
05/29/93	19:50	1347.17				57.6	58.7	90.2	90.1			132					37.5	32.8
05/30/93	19:28	1370.80				46.8	59.2	58.0				137					31.1	34.3
05/31/93	19:30	1394.83				45.8	57.4	56.7				144					30.5	33.5
06/01/93	03:40	1403.00				30.4		56.5				142						
06/01/93	19:00	1418.33				46.1		58.5				140						
06/02/93	19:00	1442.33						55.2				138						
06/03/93	12:30	1459.83				45.2						136					30.8	

Table B-2 Temperature in Thermowells (Outside Thermowell TW7 in Table B-1) [Continued]

Date	Time	Elapsed Time	TW3D 29-ft	TW4D 29-ft	TW5D 29-ft	TW6D 29-ft	TW7D 29-ft	TW1E 31-ft	TW2E 31-ft	TW3E 31-ft	TW4E 31-ft	TW5E 31-ft	TW6E 31-ft	TW7E 31-ft	TW1F 34-ft	TW2F 34-ft	TW3F 34-ft	TW4F 34-ft
Maximum Temp. --->			80.5	37.7	36.2	39.1	ERR	26.1	21.8	23	21.8	ERR	23.2	ERR	26.5	ERR	ERR	ERR
04/03/93	16:40	0.00																
04/03/93	20:05	3.42																
04/03/93	20:45	4.08													21.1			
04/03/93	19:00	2.33																
04/04/93	16:00	23.33																
04/05/93	19:30	50.83																
04/06/93	16:00	71.33																
04/07/93	19:00	98.33																
04/08/93	19:15	122.58																
04/09/93	20:00	147.33																
04/10/93	19:55	171.25																
04/12/93	20:45	220.08																
04/13/93	20:00	243.33																
04/14/93	20:25	267.75																
04/15/93	21:00	292.33																
04/16/93	14:45	310.08																
04/17/93	23:20	342.67																
04/18/93	19:14	362.57																
04/19/93	18:40	386.00																
04/20/93	16:50	410.17	21.9	22.4	22.4	22.3												
04/21/93	18:53	434.22																
04/22/93	19:14	458.57																
04/23/93	21:25	484.75	22.0			22.9				21.7								
04/24/93	20:00	507.33	22.0		23.1	22.8							22.1					
04/25/93	20:50	532.17	22.4		23.5	23.2		21.5	21.8		21.8							
04/26/93	20:30	555.83	22.3		23.6	23.3												
04/27/93	20:55	580.25																
04/28/93	18:35	601.92																
04/29/93	18:35	625.92		23.5														
04/30/93	20:00	651.33	22.9	24.7	23.8	23.7		21.1					23.2					
05/01/93	20:30	675.83	23.3	24.2	24.2	24.2			21.8	22.2			22.1					
05/02/93	20:35	699.92	23.2	24.5	24.5	24.4		21.1		22.1								
05/03/93	20:40	724.00	23.6	25.1	24.9	24.9												
05/04/93	19:08	746.47	24.9	25.6	25.0	25.3		22.5										
05/05/93	22:30	773.83	23.9	25.5	25.1	25.3		21.5	21.8	22.4								
05/06/93	21:00	796.33	25.0	26.0	26.0	26.0												
05/07/93	21:44	821.07	25.0	26.0	28.0	26.0		23.0		23.0								
05/08/93	20:04	843.40	25.5	27.1	27.3	27.1												
05/09/93	21:07	868.45	25.9	37.5		27.5												
05/10/93	?	891.75	28.1	29.7	30.1	27.6												

Table B-2 Temperature in Thermowells (Outside Thermowell TW7 in Table B-1) [Continued]

Date	Time	Elapsed Time	TW3D 29-ft	TW4D 29-ft	TW5D 29-ft	TW6D 29-ft	TW7D 29-ft	TW1E 31-ft	TW2E 31-ft	TW3E 31-ft	TW4E 31-ft	TW5E 31-ft	TW6E 31-ft	TW7E 31-ft	TW1F 34-ft	TW2F 34-ft	TW3F 34-ft	TW4F 34-ft
Maximum Temp. --->			80.5	37.7	36.2	39.1	ERR	28.1	21.8	23	21.8	ERR	23.2	ERR	28.5	ERR	ERR	ERR
05/11/93	20:10	915.50	29.6	31.4	32.1	31.3												
05/12/93	20:00	939.33	29.9	31.9	32.5	31.8												
05/13/93	20:17	963.62	30.4	32.3	33.3	32.3												
05/14/93	20:20	987.67	31.0	32.8	33.8	32.7												
05/15/93	21:00	1012.33	31.3	33.2		37.7		28.1							28.5			
05/16/93	20:50	1036.17	28.4	33.3	32.3	33.2												
05/17/93	20:22	1059.70																
05/18/93	21:30	1084.83																
05/19/93	20:00	1107.33	29.5	35.6	35.6	37.0												
05/20/93	22:05	1133.42	30.5	37.7	36.2	39.1												
05/21/93	21:10	1156.50																
05/22/93	12:55	1172.25																
05/23/93	21:25	1204.75																
05/24/93	08:00	1215.33																
05/24/93	20:10	1227.50																
05/25/93	19:00	1250.33																
05/26/93	20:25	1275.75																
05/27/93	12:11	1291.52	32.8															
05/28/93	03:00	1306.33																
05/28/93	20:20	1323.67	32.1															
05/29/93	03:30	1330.83																
05/29/93	15:00	1342.33																
05/29/93	19:50	1347.17	80.5															
05/30/93	19:28	1370.80	33.8															
05/31/93	19:30	1394.83	33.2															
06/01/93	03:40	1403.00																
06/01/93	19:00	1418.33																
06/02/93	19:00	1442.33																
06/03/93	12:30	1459.83																

Table B-2 Temperature in Thermowells (Outside Thermowell TW7 in Table B-1) [Continued]

Date	Time	Elapsed Time	TW5F 34-ft	TW6F 34-ft	TW7F 34-ft
Maximum Temp. --->			ERR	21.1	ERR
04/03/93	16:40	0.00			
04/03/93	20:05	3.42			
04/03/93	20:45	4.08			
04/03/93	19:00	2.33		21.1	
04/04/93	16:00	23.33			
04/05/93	19:30	50.83			
04/06/93	16:00	71.33			
04/07/93	19:00	98.33			
04/08/93	19:15	122.58			
04/09/93	20:00	147.33			
04/10/93	19:55	171.25			
04/12/93	20:45	220.08			
04/13/93	20:00	243.33			
04/14/93	20:25	267.75			
04/15/93	21:00	292.33			
04/16/93	14:45	310.08			
04/17/93	23:20	342.67			
04/18/93	19:14	362.57			
04/19/93	18:40	386.00			
04/20/93	18:50	410.17			
04/21/93	18:53	434.22			
04/22/93	19:14	458.57			
04/23/93	21:25	484.75			
04/24/93	20:00	507.33			
04/25/93	20:50	532.17			
04/26/93	20:30	555.83			
04/27/93	20:55	580.25			
04/28/93	18:35	601.92			
04/29/93	18:35	625.92			
04/30/93	20:00	651.33			
05/01/93	20:30	675.83			
05/02/93	20:35	699.92			
05/03/93	20:40	724.00			
05/04/93	19:08	746.47			
05/05/93	22:30	773.83			
05/06/93	21:00	796.33			
05/07/93	21:44	821.07			
05/08/93	20:04	843.40			
05/09/93	21:07	868.45			
05/10/93		891.75			

Table B-2 Temperature in Thermowells (Outside Thermowell TW7 in Table B-1) (Continued)

Date	Time	Elapsed Time	TW5F 34-ft	TW6F 34-ft	TW7F 34-ft
Maximum Temp. --->			ERR	21.1	ERR
05/11/93	20:10	915.50			
05/12/93	20:00	939.33			
05/13/93	20:17	963.62			
05/14/93	20:20	987.67			
05/15/93	21:00	1012.33			
05/16/93	20:50	1036.17			
05/17/93	20:22	1059.70			
05/18/93	21:30	1084.83			
05/19/93	20:00	1107.33			
05/20/93	22:05	1133.42			
05/21/93	21:10	1156.50			
05/22/93	12:55	1172.25			
05/23/93	21:25	1204.75			
05/24/93	08:00	1215.33			
05/24/93	20:10	1227.50			
05/25/93	19:00	1250.33			
05/26/93	20:25	1275.75			
05/27/93	12:11	1291.52			
05/28/93	03:00	1306.33			
05/28/93	20:20	1323.67			
05/29/93	03:30	1330.83			
05/29/93	15:00	1342.33			
05/29/93	19:50	1347.17			
05/30/93	19:28	1370.80			
05/31/93	19:30	1394.83			
06/01/93	03:40	1403.00			
06/01/93	19:00	1418.33			
06/02/93	19:00	1442.33			
06/03/93	12:30	1459.83			

Table B-3 Temperature in Excitor Electrodes

Date	Time	Elapsed Time	B1A	B2A	B3A	B4A	B1B	B2B	B3B	B4B	B1C	B2C	B3C	B4C	Average Temperature			
		Time	1-ft B1A	1-ft B2A	1-ft B3A	1-ft B4A	10-ft B1B	10-ft B2B	10-ft B3B	10-ft B4B	19-ft B1C	19-ft B2C	19-ft B3C	19-ft B4C	1-foot	10-Foot	20-Foot	Overall
Maximum Temp.---->			433.2	1150	464.2	330.1	725.4	1304	1280	1008.1	1170	1330	978.3	1021.1				
04/03/93	16:40	0.00	20	20	20	20	20	20	20	20	20	20	20	20	20	20	20	20
04/03/93	20:05	3.42	55.3	44.0	42.0	24.4	18.9	18.7	18.8	19.2	21.4	21.9	21.9	22.0	41	19	22	27
04/03/93	20:45	4.08	43.4	36.2	33.5	22.8	19.0	19.0	19.4	19.6	21.7	21.9	22.4	22.4	34	19	22	25
04/03/93	22:40	6.00	32.2	29.2	27.1	21.3	18.8	19.1	19.3	19.6	21.4	22.0	22.5	22.4	27	19	22	23
04/04/93	08:45	16.08	67.6	56.8	50.4	27.8	19.3	19.3	19.5	19.6	21.7	22.2	22.2	22.5	51	19	22	31
04/04/93	10:30	17.83	87.1	74.0	66.3	30.0	18.6	18.8	18.8	19.1	20.9	21.7	21.7	21.8	64	19	22	35
04/04/93	12:30	19.83	92.0	83.0	73.0	33.0	18.4	18.5	18.9	19.3	20.5	21.4	21.3	21.2	70	19	21	37
04/04/93	14:33	21.88	92.3	92.2	77.6	33.9	18.3	18.5	18.6	18.7	20.5	21.4	21.3	21.2	74	19	21	38
04/04/93	17:00	24.33	117.0	110.0	98.0	42.0	17.1	17.3	17.7	17.6	19.4	20.1	20.4	20.2	92	17	20	43
04/04/93	19:00	26.33	119.0	122.0	107.0	51.0	17.2	17.5	17.5	18.0	19.2	20.0	20.5	20.2	100	18	20	46
04/04/93	21:00	28.33	122.0	124.0	110.0	57.0	17.9	18.1	17.9	17.9	19.4	20.4	21.2	20.9	103	18	20	47
04/04/93	23:00	30.33	127.0	126.5	102.4	63.9	17.8	18.4	18.3	18.4	19.7	20.8	21.0	20.4	105	18	20	48
04/05/93	01:00	32.33	128.3	124.7	98.4	65.2	18.6	20.2	18.9	18.7	19.6	20.8	21.4	21.3	104	19	21	48
04/05/93	03:00	34.33	132.1	130.2	98.8	69.0	19.9	21.4	19.4	19.2	20.4	21.3	21.9	21.9	108	20	21	50
04/05/93	05:00	36.33	133.0	129.4	98.9	71.6	21.8	23.5	19.6	19.4	20.8	21.7	21.9	22.0	108	21	22	50
04/05/93	07:00	38.33	137.0	136.2	99.1	74.7	25.6	24.7	19.4	19.3	21.4	22.0	21.8	22.1	112	22	22	52
04/05/93	09:00	40.33	139.0	139.5	99.4	77.0	34.3	26.3	19.4	19.3	24.4	21.7	21.8	22.1	114	25	23	54
04/05/93	11:00	42.33	144.8	146.5	90.7	80.4	51.9	27.4		17.6	20.1	20.3	20.1	20.0	116	32	20	58
04/05/93	13:00	44.33	148.0	149.3	97.7	85.4	77.3	35.8	18.3	17.4	19.8	20.3	19.9	20.3	120	37	20-	59
04/05/93	15:00	46.33	146.0	150.3	99.0	90.0	106.0	57.0	18.0	18.0	20.2	19.0	20.0	20.0	121	50	20	64
04/05/93	22:00	53.33	156.0	159.0	138.0	100.0	149.0	104.0	23.0	21.0	73.0	23.0	22.0	23.0	138	74	35	83
04/06/93	02:00	57.33	160.3	167.1	146.4	104.0	147.7	133.5	24.8	21.0	100.3	24.4	23.0	22.5	144	82	43	90
04/06/93	04:00	59.33	160.2	167.5	145.3	112.6	144.4	139.4	27.2	21.4	102.3	27.0	23.6	23.0	146	83	44	91
04/06/93	06:00	61.33	159.2	169.7	149.2	128.7	142.3	151.6	28.9	21.7	104.0	34.3	23.8	23.0	152	86	46	95
04/06/93	08:00	63.33	156.8	168.1	149.8	137.5	139.5	159.4	30.0	21.1	107.8	69.5	24.1	21.7	153	88	56	99
04/06/93	14:40	70.00	154.0	167.0	156.0	158.0	137.0	157.0	44.0	78.0	102.6	98.0	25.0	22.0	159	104	62	108
04/06/93	22:00	77.33	155.0	165.0	161.0	172.0	135.0	143.0	123.0	117.0	105.0	114.0	26.0	23.0	163	130	67	120
04/07/93	02:00	81.33	152.4	163.2	161.8	175.0	134.6	140.0	131.8	135.0	104.8	113.8	26.6	23.7	163	135	67	122
04/07/93	06:00	85.33	151.0	162.1	163.3	179.7	133.5	139.5	142.0	146.5	105.1	114.3	26.6	24.5	164	140	68	124
04/07/93	08:30	87.83	149.7	160.5	162.1	178.8	132.4	138.2	143.8	149.5	104.6	112.8	26.4	25.8	163	141	67	124
04/07/93	17:00	96.33	145.0	155.0	152.0	166.0	127.0	133.0	148.0	137.0	87.4	103.0	50.0	82.0	155	136	81	124
04/07/93	22:00	101.33	143.6	154.6	154.0	168.0	128.6	134.8	151.5	134.2	81.0	96.0	84.5	75.5	155	137	84	125
04/08/93	06:00	109.33	144.1	153.9	151.1	162.6	128.4	136.4	136.9	125.1	80.5	96.0	106.0	70.2	153	132	88	124
04/08/93	19:00	122.33	149.1	158.7	155.6	164.1	130.3	138.9	135.2	123.8	78.9	93.4	115.2	70.6	157	132	90	126
04/09/93	04:00	131.33	145.1	155.9	153.4	158.9	129.6	137.7	130.7	121.1	78.0	88.9	113.7	70.6	153	130	88	124
04/09/93	13:45	141.08	150.4	160.9	159.6	163.5	130.8	140.4	134.1	123.8	81.4	92.2	117.2	74.6	159	132	91	127
04/09/93	[illegible]	145.83	150.5	161.4	160.8	162.2	130.3	139.9	132.6	123.0	84.2	92.8	116.4	75.1	159	131	92	127
04/10/93		154.33	153.3	163.6	162.2	164.1	132.0	140.6		124.6	84.5	94.7	117.7	77.4	161	133	94	129
04/10/93		163.00	153.7	164.0	161.8	163.7	131.2	139.6		123.9	83.6	94.2	115.9	78.7	161	132	33	129

Table B-3 Temperature in Excitor Electrodes (Continued)

Date	Time	Elapsed Time	B1A	B2A	B3A	B4A	B1B	B2B	B3B	B4B	B1C	B2C	B3C	B4C	Average Temperature			
			1-ft B1A	1-ft B2A	1-ft B3A	1-ft B4A	10-ft B1B	10-ft B2B	10-ft B3B	10-ft B4B	19-ft B1C	19-ft B2C	19-ft B3C	19-ft B4C	1-foot	10-Foot	20-Foot	Overall
Maximum Temp.---->		Time	433.2	1150	464.2	330.1	725.4	1304	1280	1008.1	1170	1330	978.3	1021.1				
04/10/93	20:33	171.88	155.3	166.3	162.6	165.7	131.6	140.2	131.9	125.4	83.7	94.5	116.7	80.2	162	132	94	130
04/11/93	12:42	188.03	156.4	167.9	164.2	163.2	133.3	139.6	132.6	127.1	83.7	95.4	115.3	84.9	163	133	95	130
04/11/93	22:00	197.33	145.5	156.0	148.3	151.4	125.0	129.0	121.3	117.0	72.6	85.1	100.0	75.1	150	123	83	119
04/12/93	13:15	212.58	152.4	163.7	157.0	162.0	131.5	136.0	127.4	123.2	78.8	91.7	108.1	83.1	159	130	90	126
04/13/93	06:00	229.33	157.8	169.8	163.7	170.1	134.7	139.0	132.8	128.4	86.1	95.7	111.9	90.9	165	134	96	132
04/14/93	05:00	252.33	161.2	172.7	165.8	172.7	134.9	138.3	134.2	130.2	92.3	97.8	112.2	94.8	168	134	99	134
04/15/93	04:00	275.33	165.8	176.4	168.0	176.3	138.3	140.0	136.0	132.9	97.2	103.6	114.5	97.5	172	137	103	137
04/16/93	05:00	300.33	169.4	179.6	172.6	182.4	138.7	141.1	138.5	137.1	106.5	111.2	115.7	100.5	176	139	108	141
04/17/93	06:00	325.33	172.7	181.8	174.8	185.2	140.7	141.6	139.9	139.1	116.9	115.1	117.2	103.2	179	140	113	144
04/18/93	05:16	348.60	169.5	177.5	170.0	179.1	139.1	138.6	137.1	136.3	112.3	111.6	114.2	98.5	174	138	109	140
04/19/93	04:35	371.92	178.5	185.3	178.5	192.4	143.9	141.7	142.0	142.6	127.9	132.6	136.2	123.2	184	143	130	152
04/20/93	05:30	396.83	181.5	188.2	180.7	196.2	146.8	141.3	143.3	144.9	136.5	141.1	144.0	131.5	187	144	138	156
04/21/93	11:35	426.92	182.1	188.5	180.7	194.9	149.8	141.0	143.4	145.9	144.4	143.2	145.9	132.7	187	145	142	158
04/22/93	06:00	445.33	181.6	189.7	181.7	196.6	151.5	142.0	144.2	147.3	149.8	142.2	149.9	136.2	187	146	145	159
04/23/93	06:00	469.33	182.3	189.8	182.2	197.4	152.5	141.4	145.6	148.1	153.6	148.1	152.7	138.8	188	147	148	161
04/24/93	06:00	493.33	182.3	190.3	182.8	198.8	154.4	140.8	144.8	148.6	157.1	146.8	152.9	139.2	188	147	149	161
04/25/93	06:00	517.33	184.2	193.5	184.6	199.5	159.6	141.6	146.5	151.5	166.6	149.6	158.6	146.1	190	150	156	165
04/26/93	06:00	541.33	182.9	192.8	183.7	197.5	161.9	141.6	146.7	152.1	171.6	148.8	157.2	144.3	189	151	155	165
04/27/93	05:05	564.42	187.0	196.4	187.2	201.5	169.0	142.8	149.3	155.7	188.6	154.4	166.1	153.1	193	154	166	171
04/28/93	05:30	588.83	185.6	197.1	187.4	201.2	173.2	142.9	150.6	157.4	198.7	154.7	169.1	155.9	193	156	170	173
04/29/93	08:20	615.67	187.2	199.3	189.1	203.4	179.4	143.9	153.9	160.3	213.4	158.2	176.2	161.5	195	159	177	177
04/30/93	06:10	637.50	189.5	198.4	187.4	199.0	186.2	141.8	158.4	168.3	211.1	146.5	168.9	157.7	194	164	171	176
05/01/93	14:10	669.50	183.1	195.3	182.9	189.4	203.6	138.8	162.0	162.4	194.9	135.2	162.9	142.6	188	167	159	171
05/02/93	21:06	700.43		180.9	155.0	173.7		136.5	162.7	157.7		130.6	156.5	127.6	170	152	138	153
05/03/93	07:55	711.25	164.4	171.2	150.6	172.0	171.2	138.2	164.8	159.8	183.8	130.0	156.9	131.7	165	159	151	158
05/04/93	07:25	734.75	167.7	201.3	155.5	175.3	176.3	141.8	171.5	164.3	194.6	139.5	168.5	140.1	175	163	161	166
05/04/93	23:00	750.33	170.2	213.9	158.6	177.9	180.3	143.6	176.2	166.9	201.5	147.7	178.3	145.2	180	167	168	172
05/05/93	23:00	774.33	178.2	233.4	157.1	179.0	178.0	145.9	180.9	170.3	206.3	153.3	188.3	149.4	187	169	174	177
05/06/93	07:00	782.33	165.7	252.8	155.5	178.1	177.6	146.3	181.5	170.7	206.7	154.5	190.4	149.4	188	169	175	177
05/06/93	15:50	791.17	168.2	283.4	158.9	178.1	177.7	146.6	183.0	170.9	207.8	159.7	195.3	149.6	197	170	178	182
05/06/93	23:05	798.42	168.1	304.7	158.5	179.1	179.7	148.0	184.7	172.1	209.3	171.6	203.0	151.2	203	171	184	186
05/07/93	07:10	806.50	169.4	326.7	157.9	179.6	179.8	149.2	186.5	173.3	211.6	183.3	212.4	153.2	208	172	190	190
05/07/93	15:30	814.83	168.0	339.7	159.0	179.2	178.9	149.9	187.4	173.7	211.7	188.8	217.5	154.5	211	172	193	192
05/07/93	22:53	822.22	166.2	351.9	158.8	179.8	179.0	151.2	189.0	174.5	213.5	193.4	224.5	156.7	214	173	197	195
05/08/93	07:00	830.33	166.2	356.9	157.8	178.9	177.9	152.4	189.2	174.8	213.9	194.5	227.4	158.7	215	174	199	196
05/08/93	15:25	838.75	162.4	332.8	156.7	174.6	173	152.4	186.5	172.6	206.8	185.5	218.1	154	207	171	191	190
05/08/93	23:00	846.33	163.5	355.1	157.3	176.8	175.7	153.9	190.5	174.5	212.7	193.9	236.7	159.4	213	174	201	196
05/09/93	07:06	854.43	163.9	368	157.7	177.3	176.5	155.7	192.7	175.6	215.6	197.5	237.1	162.5	217	175	203	198
05/09/93	15:15	862.58	163.6	375.9	158.8	176.5	176	156.3	193.5	175.7	217.1	198.6	240.7	164	219	175	205	200

Table B-3 Temperature in Excitor Electrodes (Continued)

Date	Time	Elapsed Time	B1A	B2A	B3A	B4A	B1B	B2B	B3B	B4B	B1C	B2C	B3C	B4C	Average Temperature			
		Time	1-ft B1A	1-ft B2A	1-ft B3A	1-ft B4A	10-ft B1B	10-ft B2B	10-ft B3B	10-ft B4B	19-ft B1C	19-ft B2C	19-ft B3C	19-ft B4C	1-foot	10-Foot	20-Foot	Overall
Maximum Temp.---->			433.2	1150	464.2	330.1	725.4	1304	1280	1008.1	1170	1330	978.3	1021.1				
05/09/93	23:10	870.50	164.4	385.8	159.1	177.4	176.9	158.1	195.3	177.4	219.2	201.2	246	168.6	222	177	208	202
05/10/93	07:10	878.50	162.9	398.3	157.4	176.9	162.9	160	196.2	177.6	220.5	203.1	248.9	168.6	224	174	210	203
05/11/93	07:15	902.58	162.1	472.6	156.6	175.5	173.1	164.8	198	176.8	221.9	204.5	247.8	171.4	242	179	211	211
05/12/93	07:00	926.33	156.1	512.6	152.9	166.9	163.9	167.5	194.4	175.6	208.1	192.1	227.6	160.8	247	175	197	207
05/13/93	07:08	950.47	161.4	885.7	155.4	170.9	173.1	181.3	200.6	179.6	209.4	237.4	244	171	343	184	215	247
05/14/93	07:00	974.33	158.7	858.6	154.7	169.5	174.7	192.8	200.6	180.2	207.6	262.9	236.3	170.6	335	187	219	247
05/15/93	07:14	998.57	159.8	871.2	156.8	170.9	177.5	206.4	204.6	182.6	212.9	353.1	243.8	178.2	340	193	247	260
05/16/93	07:33	1022.88	161.2	860.6	156.6	170.7	178.2	208.3	212.1	183.8	216.9	775.5	257.6	180.1	337	195	358	297
05/17/93	23:00	1062.33	167.2	859.9	158	169	179.5	194.4	230.4	186.4	227.9	528.1	421.9	192.8	339	198	343	293
05/18/93	23:30	1086.83	158.6	679.6	154.9	160.6	167.9	195.7	256.1	188.1	226.7	445.2	850.9	201.1	288	202	431	307
05/19/93	22:50	1110.17	156	651.8	158.4	155.5	158.7	210.8	325.8	203.6	223.7				280	225	224	249
05/20/93	07:08	1118.47	152.3	614.8	154	151.6	153.8	223.6	376.6	202.2	218.9	1330			268	239	774	358
05/20/93	17:25	1128.75	147.5	494.5	148.6	145.1	147.3	206.8	277.7	195.8	211.6			237	234	207	224	221
05/21/93	23:05	1158.42	157.3	636.5	147	142.5	145.2	323.3	596.8	209.5	215.7		834.5	230.6	271	319	427	331
05/22/93	22:35	1181.92	164.7	880.2	154	147.3	158.6	820	976.3	254	230.8	719.4	978.3	334.2	337	552	566	485
05/23/93	23:05	1206.42	171.5	983.4	163.5	152.2	172.2	984.4	882.4	275.8	244.2	858.2	891.2	399.5	368	579	598	515
05/24/93	22:55	1230.25	183.1	847.8	168.8	148.3	213.1	880.1	572.1	273.8	895.7	847.6	551.2	314.3	337	485	652	491
05/25/93	23:08	1254.47	212.8	912.9	186.7	150.5	329.7	796.3	840.6	284.7	1069.8	847.2	839	346.6	366	563	776	568
05/26/93	22:55	1278.25	236.6	1150.0	208.0	152.0	498.5	1304.0	1119.0	284.7	1170.0	861.9	555.0	295.1	437	802	721	653
05/27/93	07:01	1286.35	227.4	1055.2	208.1	151.5	517.6	1174.0	1238.0	282.5	1028.0	995.0	507.0	275.7	411	803	701	638
05/28/93	07:06	1310.43	244.9	895.2	219.8	156.9	725.4	993.3	1280.0	290.4	997.2	950.0	474.7	330.5	379	822	688	630
05/29/93	07:15	1334.58	433.2	928.0	232.5	165.3	219.5	856.9	1220.0	308.1	885.2	806.7	483.0	578.8	440	651	688	593
05/30/93	07:20	1358.67	298.1		229.3	169.3	166.3			302.8		468.6	439.5	873.6	232	235	594	368
05/31/93	07:10	1382.50	238.1		223.7	178.4	155.0			388.6	603.0	363.1	405.8	637.9	213	272	502	355
06/01/93	05:00	1404.33	251.1	895.7	218.3	181.8	155.0	1120.0		605.6	996.0	328.2	396.9	609.0	387	627	583	523
06/02/93	05:50	1429.17	219.8		241.1	330.1	154.9			1008.1		324.6		1021.1	264	582	673	471
06/03/93	12:07	1459.45	248.0		464.2		121.8		630.0			347.7		194.6	356	378	271	334

Table B-4 Ground Electrode and Outside Thermowell Temperatures
(Recorded by Data Logger)

Date	Time	Elapsed Time	A2A	A2B	A2C	A3A	A3B	A3C	A3D	A4A	A4B	A4C	A4D	TW7B	TW7C	TW7D
	Maximum Temp. --		78.5	84.2	42.3	80.3	95.5	45.4	32.0	112.2	98.8	48.7	33.9	62.0	38.7	27.7
04/03/93	16:00	-0.7	17.9	19.8	21.8	18.3	19.9	21.9	21.9	18.1	19.8	21.9	22.0	19.3	21.7	21.9
04/03/93	20:00	3.3	18.5	19.7	22.0	19.0	20.0	22.0	22.0	19.0	19.8	22.0	21.9	19.4	21.7	21.9
04/04/93	00.00	7.3	18.8	19.7	22.0	19.0	20.0	22.0	22.0	19.1	19.8	22.0	22.0	19.4	21.8	22.0
04/04/93	04:00	11.3	18.6	19.7	22.0	19.2	20.1	22.1	22.1	19.6	19.8	22.1	22.0	19.5	21.7	22.0
04/04/93	08.00	15.3	18.8	19.7	22.0	19.4	20.1	22.1	22.1	19.9	19.7	22.1	22.0	19.4	21.8	22.0
04/04/93	12:00	19.3	19.0	19.4	21.5	19.7	19.9	21.7	21.6	20.5	19.5	21.9	21.7	19.2	21.5	21.8
04/04/93	16:00	23.3	19.8	19.4	21.8	21.1	19.8	21.9	21.9	22.8	19.5	21.8	21.9	19.1	21.8	21.7
04/04/93	20:00	27.3	20.6	19.6	22.0	22.4	19.8	21.9	22.0	24.8	19.4	22.0	21.8	19.3	21.6	21.7
04/05/93	00:00	31.3	21.1	19.6	22.1	23.0	19.9	22.0	22.0	26.0	19.5	22.0	22.0	19.4	21.8	21.8
04/05/93	04:00	35.3	21.4	19.5	21.9	23.4	19.8	22.0	21.9	27.1	19.4	22.0	21.9	19.3	21.6	21.8
04/05/93	08.00	39.3	21.8	19.4	21.8	23.8	19.8	21.9	21.9	28.1	19.3	22.0	21.8	19.2	21.5	21.7
04/05/93	12:00	43.3	22.1	19.2	21.1	23.8	19.6	21.6	21.5	29.0	19.4	21.8	21.5	18.8	21.4	21.4
04/05/93	16.00	47.3	23.1	19.1	21.4	25.0	19.5	21.6	21.6	30.9	19.2	21.7	21.6	18.7	21.3	21.4
04/05/93	20.00	51.3	24.2	19.6	21.8	26.3	19.9	21.8	21.8	32.8	19.4	21.8	21.7	19.3	21.3	21.5
04/06/93	00.00	55.3	24.9	19.8	22.0	27.2	19.9	22.0	21.9	34.3	19.5	22.1	21.9	19.3	21.5	21.7
04/06/93	04:00	59.3	25.6	19.5	21.8	27.8	19.9	22.0	21.8	35.7	19.5	22.0	21.8	19.2	21.6	21.7
04/06/93	08.00	63.3	26.1	19.5	21.9	28.5	19.9	22.1	21.8	36.8	19.7	22.1	21.9	19.2	21.7	21.8
04/06/93	12:00	67.3	26.7	19.6	21.8	29.1	20.1	22.0	21.9	38.1	19.8	22.1	21.9	19.2	21.7	21.7
04/06/93	16.00	71.3	27.6	19.7	22.0	30.2	20.2	22.2	22.0	39.9	19.9	22.2	22.0	19.3	21.7	21.9
04/06/93	20.00	75.3	28.4	19.9	21.9	31.2	20.2	22.2	22.0	41.4	20.0	22.2	21.9	19.4	21.8	21.8
04/07/93	00.00	79.3	29.1	19.8	21.9	32.0	20.2	22.2	21.9	42.7	20.2	22.2	21.8	19.4	21.5	21.6
04/07/93	04:00	83.3	29.8	19.8	21.8	32.8	20.4	22.1	21.8	44.0	20.3	22.2	21.8	19.4	21.6	21.7
04/07/93	08.00	87.3	30.4	19.8	21.9	33.6	20.4	22.1	21.9	45.1	20.4	22.1	21.9	19.4	21.6	21.7
04/07/93	12.00	91.3	31.1	19.8	22.0	34.5	20.5	22.3	21.9	46.2	20.5	22.3	21.9	19.4	21.6	21.7
04/07/93	16.00	95.3	31.1	19.4	21.4	34.4	20.4	22.0	21.6	46.8	20.5	22.1	21.7	18.9	21.6	21.4
04/07/93	20.00	99.3	32.2	19.9	22.0	36.0	20.7	22.2	21.8	48.6	20.7	22.1	21.8	19.4	21.5	21.6
04/08/93	00.00	103.3	32.8	19.8	21.9	36.8	20.8	22.1	21.8	49.6	20.8	22.2	21.7	19.3	21.5	21.6
04/08/93	04.00	107.3	33.1	20.0	21.9	37.4	21.0	22.3	21.8	50.1	21.2	22.4	21.8	19.3	21.7	21.7
04/08/93	08.00	111.3	33.7	20.0	22.0	38.4	21.1	22.3	21.8	51.1	21.4	22.4	21.9	19.4	21.6	21.8
04/08/93	12.00	115.3	33.8	19.9	21.7	38.7	21.1	22.0	21.8	51.4	21.5	22.1	21.8	19.1	21.6	21.7
04/08/93	16.00	119.3	34.4	19.9	21.8	39.7	21.2	22.1	21.7	52.1	21.8	22.3	21.7	19.2	21.6	21.6

Date	Time	C6D	C1B	C1C	C2A	C2B	C2C	C2D	C3A	C3B	C3C	C3D	C4A	C4B	C4C	C4D	C8B
	Maximum Temp. --	30.5	88.4	42.6	82.0	84.7	48.7	31.9	98.3	98.5	52.0	32.7	92.1	98.3	49.4	31.9	90.1
04/03/93	16:00	21.9	19.1	21.5	18.3	19.1	21.6	21.9	18.4	19.8	21.7	21.9	18.6	19.8	21.8	21.9	21.0
04/03/93	20:00	22.1	19.3	21.7	18.8	19.2	21.7	21.9	19.1	19.9	21.7	21.9	19.6	20.0	21.8	21.9	21.1
04/04/93	00.00	22.0	19.2	21.7	18.9	19.2	21.8	21.9	19.2	19.9	21.8	21.9	19.6	20.0	21.8	21.9	21.1
04/04/93	04:00	22.1	19.3	21.8	18.8	19.2	21.7	22.0	19.5	20.0	21.8	21.9	20.1	20.1	21.9	22.0	21.3
04/04/93	08.00	21.9	19.3	21.8	18.8	19.2	21.9	22.0	19.7	20.0	21.9	22.0	20.3	20.0	21.9	21.9	21.0
04/04/93	12:00	21.6	19.1	21.3	18.7	18.7	21.5	21.6	20.1	19.8	21.6	21.7	21.1	19.7	21.6	21.6	20.6
04/04/93	16:00	21.7	18.9	21.5	19.5	18.9	21.5	21.7	21.7	19.8	21.5	21.7	23.7	19.7	21.7	21.7	21.0
04/04/93	20:00	21.9	19.1	21.7	20.5	19.2	21.6	21.9	23.2	19.8	21.6	21.8	25.9	20.0	21.6	21.7	21.1
04/05/93	00:00	21.9	19.2	21.7	20.7	19.2	21.7	21.9	23.9	19.9	21.7	21.8	27.1	20.0	21.8	21.8	21.3
04/05/93	04:00	21.9	19.1	21.5	20.8	19.1	21.6	21.9	24.4	19.9	21.6	21.8	28.0	19.9	21.8	21.7	21.0
04/05/93	08.00	21.7	18.9	21.5	20.9	19.1	21.6	21.8	24.9	19.8	21.6	21.8	28.8	19.8	21.6	21.6	20.9
04/05/93	12:00	21.2	18.7	20.9	20.5	18.5	21.4	21.4	25.3	19.2	21.5	21.6	29.9	19.2	21.5	21.3	20.3
04/05/93	16.00	21.3	18.5	21.0	21.6	18.5	21.2	21.5	26.5	19.3	21.3	21.5	31.6	19.4	21.3	21.3	20.5
04/05/93	20.00	21.6	19.1	21.5	22.9	19.4	21.4	21.6	27.9	20.0	21.4	21.6	33.1	20.1	21.4	21.5	20.9
04/06/93	00.00	21.9	19.0	21.6	23.5	19.3	21.6	21.8	28.9	19.9	21.6	21.8	34.1	20.0	21.7	21.7	21.0
04/06/93	04:00	21.6	19.0	21.5	23.8	19.2	21.5	21.8	29.9	19.9	21.6	21.7	35.1	20.0	21.7	21.6	21.0
04/06/93	08.00	21.7	19.0	21.5	24.2	19.1	21.6	21.8	30.4	19.9	21.7	21.8	35.1	20.0	21.8	21.7	21.0
04/06/93	12:00	21.7	19.0	21.4	24.5	19.1	21.7	21.9	31.1	19.9	21.8	21.9	36.0	20.1	21.8	21.7	21.0
04/06/93	16.00	21.9	19.2	21.7	25.5	19.4	21.7	21.9	32.3	20.2	21.8	21.9	37.2	20.4	21.8	21.8	21.3
04/06/93	20.00	21.9	19.2	21.8	26.3	19.5	21.8	21.9	33.1	20.4	21.8	21.9	38.0	20.6	21.8	21.8	21.6
04/07/93	00.00	21.8	19.3	21.5	26.8	19.5	21.5	21.8	34.0	20.5	21.6	21.7	38.8	20.6	21.7	21.7	21.5
04/07/93	04:00	21.7	19.2	21.5	27.3	19.4	21.6	21.7	34.6	20.5	21.7	21.6	39.4	20.7	21.8	21.7	21.7
04/07/93	08.00	21.8	19.2	21.5	27.8	19.3	21.7	21.8	35.4	20.6	21.7	21.8	40.2	20.9	21.8	21.7	21.8
04/07/93	12.00	21.8	19.1	21.6	28.5	19.4	21.6	21.8	36.1	20.9	21.7	21.8	41.1	21.0	21.7	21.8	21.9
04/07/93	16.00	21.3	18.7	21.0	28.1	18.6	21.3	21.5	36.1	20.4	21.6	21.6	41.3	20.6	21.7	21.4	21.5
04/07/93	20.00	21.8	19.2	21.6	29.5	19.5	21.5	21.7	37.6	21.2	21.6	21.7	43.2	21.6	21.7	21.6	22.1
04/08/93	00.00	21.7	19.0	21.5	30.0	19.4	21.5	21.7	38.4	21.2	21.6	21.7	44.5	21.6	21.7	21.6	22.2
04/08/93	04.00	21.7	19.2	21.5	30.3	19.4	21.7	21.8	38.9	21.4	21.9	21.8	44.8	21.8	21.9	21.7	22.3
04/08/93	08.00	21.8	19.2	21.6	30.9	19.7	21.6	21.8	40.1	21.6	21.8	21.8	46.4	22.1	21.8	21.8	22.6
04/08/93	12.00	21.5	19.0	21.2	30.8	19.4	21.6	21.6	40.6	21.5	21.7	21.7	46.9	22.0	21.8	21.5	22.3
04/08/93	16.00	21.5	19.0	21.3	31.6	19.5	21.5	21.6	41.3	21.8	21.6	21.6	47.3	22.5	21.7	21.6	22.6

Table B-4 Ground Electrode and Outside Thermowell Temperatures
(Recorded by Data Logger) [Continued]

Date	Time	Elapsed Time	A2A	A2B	A2C	A3A	A3B	A3C	A3D	A4A	A4B	A4C	A4D
	Maximum Temp.--		79.5	84.2	42.3	86.3	85.5	45.4	32.0	112.2	86.6	48.7	33.9
04/08/93	20.00	123.3	35.3	20.5	22.2	41.1	21.6	22.3	21.9	53.7	22.0	22.3	21.8
04/09/93	00.00	127.3	35.9	20.5	22.3	42.0	21.9	22.5	22.0	54.9	22.5	22.6	22.0
04/09/93	04.00	131.3	36.0	20.5	22.1	42.3	22.0	22.3	21.8	55.1	22.7	22.5	21.9
04/09/93	08.00	135.3	36.2	20.6	22.2	43.0	22.3	22.5	21.9	55.8	23.3	22.7	21.9
04/09/93	12.00	139.3	36.4	20.8	21.9	43.0	22.4	22.4	21.7	56.1	23.7	22.8	21.7
04/09/93	16.00	143.3	36.8	20.6	21.8	43.8	22.5	22.3	21.7	56.9	23.8	22.4	21.7
04/09/93	20.00	147.3	37.4	21.0	22.3	44.8	22.8	22.3	21.8	57.8	24.0	22.4	21.8
04/10/93	00.00	151.3	38.2	21.3	22.4	45.7	23.1	22.6	22.0	58.8	24.7	22.8	21.9
04/10/93	04.00	155.3	38.2	21.3	22.3	46.1	23.3	22.8	21.9	59.2	25.2	22.7	21.9
04/10/93	08.00	159.3	38.3	21.4	22.2	46.5	23.5	22.6	21.8	59.6	25.8	22.7	21.8
04/10/93	12.00	163.3	38.8	21.5	22.0	46.8	24.1	22.8	21.9	59.4	26.6	23.1	21.9
04/10/93	16.00	167.3	38.8	21.5	22.0	47.1	24.0	22.5	21.7	60.2	26.7	22.8	21.7
04/10/93	20.00	171.3	39.6	22.0	22.5	48.4	24.4	22.6	21.9	61.1	27.2	22.7	21.8
04/11/93	00.00	175.3	40.0	22.1	22.4	49.0	24.8	22.7	21.8	62.0	27.9	22.8	21.9
04/11/93	04.00	179.3	40.3	22.3	22.5	49.6	25.1	22.7	21.9	62.4	28.5	22.9	21.9
04/11/93	08.00	183.3	40.4	22.3	22.2	49.8	25.5	22.8	21.7	62.6	29.2	23.0	21.7
04/11/93	12.00	187.3	40.7	22.7	22.2	50.1	26.0	22.9	21.8	62.9	30.0	23.2	21.8
04/11/93	16.00	191.3	40.6	22.6	22.3	49.6	26.1	22.7	21.8	61.5	30.5	23.0	21.9
04/11/93	20.00	195.3	41.4	23.3	22.8	50.9	26.6	22.8	22.0	62.6	30.8	22.9	21.9
04/12/93	00.00	199.3	41.6	23.3	22.7	51.0	27.1	23.0	22.0	62.7	31.9	23.3	22.0
04/12/93	04.00	203.3	41.8	23.5	22.6	51.6	27.3	22.9	21.9	63.2	32.4	23.2	21.9
04/12/93	08.00	207.3	41.9	23.7	22.5	51.9	27.8	23.0	21.8	63.8	33.2	23.2	21.8
04/12/93	12.00	211.3	42.0	24.0	22.7	52.1	28.2	23.1	21.9	63.9	33.9	23.5	22.1
04/12/93	16.00	215.3	42.3	24.0	22.4	52.5	28.5	22.9	21.8	64.7	34.3	23.2	21.8
04/12/93	20.00	219.3	42.9	24.7	23.0	53.5	28.9	23.2	22.1	65.6	35.0	23.4	22.1
04/13/93	00.00	223.3	43.2	24.8	22.9	54.0	29.5	23.2	22.0	66.4	36.0	23.5	22.1
04/13/93	04.00	227.3	43.4	24.9	22.8	54.4	29.9	23.1	22.0	67.0	36.7	23.4	22.1
04/13/93	08.00	231.3	43.5	25.1	22.8	54.8	30.4	23.2	22.0	67.4	37.5	23.5	22.1
04/13/93	12.00	235.3	43.6	25.3	22.5	54.8	30.6	23.2	21.8	67.6	38.1	23.5	21.8
04/13/93	16.00	239.3	44.1	25.8	22.9	55.6	31.1	23.3	22.0	68.2	38.8	23.7	22.0
04/13/93	20.00	243.3	44.6	26.0	23.0	56.2	31.8	23.5	22.1	68.7	39.7	23.9	22.1
04/14/93	00.00		44.7	26.2	23.0	56.5	32.3	23.4	22.1	69.0	40.5	23.8	22.2

Date	Time	TW7B	TW7C	TW7D	C6D	C1B	C1C	C2A	C2B	C2C	C2D	C3A	C3B	C3C	C3D	C4A	C4B	C4C	C4D	C6B
	Maximum Temp.--	62.0	38.7	27.7	30.5	68.4	42.6	82.0	84.7	48.7	31.9	96.3	98.5	52.0	32.7	92.1	96.3	49.4	31.9	90.1
04/08/93	20.00	19.5	21.5	21.7	21.8	19.4	21.7	33.0	20.2	21.7	21.8	42.8	22.4	21.7	21.7	49.6	23.2	21.8	21.7	23.2
04/09/93	00.00	19.6	21.7	21.8	21.8	19.4	21.7	33.6	20.3	21.8	21.9	43.9	22.8	21.9	21.9	50.7	23.8	21.9	21.8	23.6
04/09/93	04.00	19.4	21.6	21.6	21.7	19.4	21.8	33.6	20.3	21.7	21.8	44.0	22.9	21.7	21.7	50.5	24.0	21.9	21.6	23.7
04/09/93	08.00	19.5	21.8	21.8	21.8	19.4	21.6	33.9	20.4	21.9	21.8	44.9	23.2	22.0	21.9	51.4	24.4	22.2	21.8	24.0
04/09/93	12.00	19.2	21.8	21.8	21.6	19.3	21.4	33.7	20.1	21.9	21.8	45.2	23.3	22.1	21.9	51.8	24.7	22.1	21.7	24.4
04/09/93	16.00	19.2	21.5	21.5	21.5	19.1	21.2	34.4	20.3	21.6	21.6	45.9	23.6	21.8	21.6	52.5	25.3	21.9	21.4	24.4
04/09/93	20.00	19.5	21.3	21.5	21.7	19.5	21.7	35.7	20.9	21.6	21.6	47.1	24.4	21.5	21.5	53.8	26.1	21.7	21.5	24.9
04/10/93	00.00	19.7	21.5	21.6	21.8	19.7	21.9	36.4	21.2	21.9	21.9	48.1	24.9	21.9	21.7	54.6	27.1	22.0	21.7	25.4
04/10/93	04.00	19.6	21.6	21.6	21.8	19.7	21.6	36.5	21.3	21.9	21.8	48.6	25.3	22.0	21.8	55.0	27.8	22.2	21.7	25.7
04/10/93	08.00	19.6	21.6	21.6	21.5	19.8	21.5	36.5	21.3	21.9	21.8	49.2	25.6	22.1	21.7	55.5	28.3	22.2	21.5	25.9
04/10/93	12.00	19.4	22.0	21.8	21.7	19.8	21.8	36.4	21.2	22.2	21.9	49.4	25.8	22.5	21.9	55.2	28.7	22.5	21.8	26.1
04/10/93	16.00	19.5	21.5	21.5	21.4	19.5	21.3	37.1	21.3	21.7	21.5	50.2	26.1	21.9	21.6	56.1	29.6	22.2	21.4	26.6
04/10/93	20.00	19.9	21.4	21.5	21.8	19.9	21.7	38.5	22.2	21.8	21.8	51.5	27.1	22.0	21.6	57.6	30.9	22.0	21.6	27.5
04/11/93	00.00	20.0	21.5	21.6	21.7	20.1	21.7	38.9	22.3	22.0	21.7	52.3	27.5	22.1	21.7	58.2	31.7	22.2	21.6	27.9
04/11/93	04.00	20.0	21.6	21.6	21.8	20.0	21.7	39.1	22.5	22.0	21.8	52.9	28.0	22.2	21.8	58.6	32.6	22.4	21.6	28.4
04/11/93	08.00	19.8	21.7	21.6	21.6	20.0	21.5	39.1	22.4	22.0	21.7	53.3	28.3	22.3	21.7	58.9	33.1	22.4	21.6	28.7
04/11/93	12.00	19.8	22.0	21.9	21.7	20.2	21.5	39.3	22.5	22.3	21.9	53.8	28.5	22.6	22.0	59.4	33.6	22.8	21.8	29.2
04/11/93	16.00	19.9	21.6	21.6	21.6	20.0	21.4	39.4	22.7	22.0	21.6	52.8	29.2	22.3	21.7	58.9	34.4	22.5	21.6	29.0
04/11/93	20.00	20.2	21.5	21.6	21.8	20.5	22.0	40.9	23.6	22.2	21.8	54.5	30.1	22.2	21.7	59.4	35.5	22.5	21.6	30.0
04/12/93	00.00	20.6	21.9	21.9	21.9	20.7	21.9	40.9	23.6	22.4	21.9	54.7	30.6	22.6	21.9	59.6	36.1	22.8	21.9	30.5
04/12/93	04.00	20.5	21.7	21.7	21.7	20.7	21.8	41.1	23.9	22.2	21.8	55.4	31.2	22.5	21.8	60.2	36.8	22.9	21.7	31.0
04/12/93	08.00	20.6	21.8	21.6	21.6	20.7	21.7	41.1	24.0	22.2	21.7	55.9	31.6	22.5	21.7	60.5	37.3	22.9	21.7	31.4
04/12/93	12.00	20.6	22.0	21.8	21.8	20.9	21.8	41.1	24.2	22.5	21.9	56.0	32.1	22.8	21.9	60.2	37.8	23.0	21.9	31.7
04/12/93	16.00	20.4	21.8	21.5	21.5	20.7	21.5	41.4	24.3	22.1	21.6	56.7	32.6	22.5	21.6	61.2	38.5	22.9	21.5	33.0
04/12/93	20.00	21.0	21.8	21.6	22.0	21.2	22.1	42.4	25.2	22.4	21.9	57.5	33.5	22.7	21.9	61.8	39.5	23.0	21.8	33.0
04/13/93	00.00	21.1	22.0	21.8	22.0	21.3	22.0	42.6	25.3	22.5	22.0	58.1	34.0	22.9	22.0	62.4	40.3	23.2	21.9	33.5
04/13/93	04.00	21.2	22.1	21.9	21.9	21.4	21.9	42.7	25.4	22.5	21.9	58.5	34.6	22.9	21.9	62.8	41.0	23.2	21.8	33.8
04/13/93	08.00	21.3	22.1	21.8	21.9	21.5	22.0	42.9	25.7	22.5	21.9	58.9	35.1	23.0	22.0	62.9	41.7	23.2	21.9	34.3
04/13/93	12.00	21.0	21.9	21.6	21.6	21.3	21.6	42.8	25.7	22.4	21.7	59.2	35.4	23.0	21.7	63.1	42.1	23.3	21.6	34.4
04/13/93	16.00	21.5	22.0	21.8	21.9	21.7	22.0	43.5	26.4	22.5	21.9	59.9	36.3	23.1	21.9	63.5	43.1	23.3	21.8	35.1
04/13/93	20.00	21.8	22.0	21.8	22.0	21.9	22.1	44.0	26.7	22.7	22.0	60.5	37.0	23.1	22.0	64.0	44.1	23.5	21.9	35.7
04/14/93	00.00	21.9	22.2	[illegible]	22.0	22.1	22.0	44.1	26.9	22.7	21.9	60.8	37.6	23.2	22.0	64.1	44.7	23.5	21.9	35.1

Table B-4 Ground Electrode and Outside Thermowell Temperatures
(Recorded by Data Logger) [Continued]

Date	Time	Elapsed Time	A2A	A2B	A2C	A3A	A3B	A3C	A3D	A4A	A4B	A4C	A4D	TW7B	TW7C	TW7D	C6D	C1B	C1C	C2A	C2B	C2C	C2D	C3A	C3B	C3C	C3D	C4A	C4B	C4C	C4D	C6B
Maximum Temp.--			79.5	84.2	42.3	86.3	95.5	45.4	32.0	112.2	98.8	48.7	33.8	82.0	38.7	27.7	30.5	88.4	42.6	82.0	84.7	48.7	31.9	96.3	98.5	52.0	32.7	92.1	96.3	49.4	31.9	90.1
04/14/93	04:00	251.3	44.9	26.5	23.0	57.0	32.8	23.4	22.0	68.7	41.4	23.8	22.2	22.0	22.2	21.7	22.0	22.2	22.1	44.4	27.1	22.8	22.0	61.1	38.2	23.2	22.0	64.4	45.6	23.6	22.0	36.7
04/14/93	08:00	255.3	45.1	26.9	23.0	57.3	33.3	23.5	22.1	68.3	42.1	23.8	22.2	22.2	22.2	21.8	22.0	22.3	22.1	44.6	27.5	22.7	22.0	61.4	38.9	23.2	22.0	64.4	46.5	23.6	21.9	37.1
04/14/93	12:00	259.3	45.1	27.0	22.7	57.3	33.5	23.3	21.8	68.0	42.7	23.9	21.8	22.0	22.1	21.6	21.7	22.2	21.9	44.4	27.6	22.8	21.8	61.4	39.1	23.3	21.8	64.4	46.9	23.6	21.7	37.1
04/14/93	16:00	263.3	45.6	27.4	23.0	57.9	33.9	23.4	21.9	68.5	43.6	23.9	21.9	22.2	22.0	21.6	21.6	22.4	21.9	45.2	28.1	22.7	21.7	62.0	39.9	23.1	21.7	65.0	47.8	23.6	21.6	37.6
04/14/93	20:00	267.3	46.1	28.0	23.4	58.8	34.9	23.6	22.1	68.9	44.5	23.9	22.0	22.6	22.0	21.6	21.9	22.8	22.4	46.1	28.9	22.8	21.9	62.8	41.0	23.2	21.8	65.6	48.9	23.7	21.8	38.5
04/15/93	00:00	271.3	46.1	28.3	23.3	58.9	35.5	23.6	22.1	69.6	45.5	24.1	22.2	22.9	22.2	21.8	22.0	22.9	22.2	46.0	29.2	22.9	22.0	62.9	41.7	23.4	22.0	65.8	49.7	24.0	21.9	39.2
04/15/93	04:00	275.3	46.1	28.5	23.2	59.1	36.0	23.6	22.1	69.7	46.4	24.2	22.1	23.0	22.2	21.7	21.9	23.1	22.3	45.9	29.5	22.9	22.0	62.8	42.3	23.5	22.0	65.4	50.3	24.2	21.9	39.6
04/15/93	08:00	279.3	46.0	28.8	23.1	58.9	36.5	23.7	22.0	69.5	47.2	24.2	22.1	23.1	22.2	21.7	21.7	23.2	22.1	45.7	29.8	23.0	22.0	62.6	42.9	23.5	22.0	65.5	50.9	24.1	21.7	40.0
04/15/93	12:00	283.3	45.8	28.7	22.7	58.4	36.9	23.5	21.7	69.0	48.0	24.1	21.8	22.8	22.2	21.5	21.5	23.0	21.8	45.3	29.6	22.8	21.6	62.4	43.1	23.5	21.8	65.1	51.4	24.0	21.6	40.0
04/15/93	16:00	287.3	45.6	28.9	22.8	58.5	37.1	23.4	21.8	69.2	48.5	24.0	21.8	23.1	22.1	21.4	21.5	23.1	21.7	45.6	29.9	22.6	21.6	62.7	43.6	23.3	21.6	65.2	52.2	23.9	21.4	40.3
04/15/93	20:00	291.3	46.5	28.7	23.2	59.3	38.0	23.7	22.0	69.7	49.5	24.0	22.2	23.6	22.1	21.7	22.0	23.6	22.3	46.8	31.2	22.8	21.9	63.4	44.9	23.4	21.8	66.0	53.6	24.0	21.8	41.3
04/16/93	00:00	295.3	46.6	30.3	23.5	59.6	38.8	23.9	22.2	69.8	50.6	24.4	22.2	24.0	22.2	21.7	22.0	24.0	22.4	46.8	31.9	23.0	22.0	63.6	45.9	23.7	21.9	66.2	54.7	24.3	21.9	41.9
04/16/93	04:00	299.3	46.6	30.5	23.3	59.8	39.4	23.9	22.1	69.5	51.4	24.4	22.2	24.1	22.2	21.7	22.0	24.0	22.2	46.6	32.3	23.1	22.0	63.6	46.4	23.7	22.0	66.0	55.5	24.4	21.8	42.3
04/16/93	08:00	303.3	46.4	30.8	23.2	59.4	40.1	23.9	22.0	69.2	52.4	24.6	22.2	24.3	22.4	21.8	21.9	24.2	22.2	46.3	32.6	23.1	22.0	63.5	47.0	23.9	22.0	65.9	56.2	24.5	21.9	42.6
04/16/93	12:00	307.3	46.4	31.0	23.1	59.1	40.6	23.9	22.1	68.9	53.3	24.5	22.2	24.2	22.6	21.8	21.9	24.2	22.2	46.1	32.7	23.2	22.0	63.5	47.5	24.0	22.1	65.9	56.7	24.5	22.0	42.8
04/16/93	16:00	311.3	46.4	31.2	23.2	59.3	40.9	23.8	21.9	68.9	53.7	24.4	22.1	24.5	22.2	21.5	21.7	24.4	22.0	46.4	33.1	22.9	21.8	63.6	48.2	23.7	21.8	65.9	57.5	24.4	21.6	43.2
04/16/93	20:00	315.3	47.0	32.0	23.5	60.0	41.8	24.0	22.1	69.4	54.8	24.5	22.2	24.9	22.3	21.6	22.0	24.8	22.5	47.2	34.1	23.1	22.0	64.1	49.5	23.8	21.9	66.2	58.9	24.4	21.9	44.0
04/17/93	00:00	319.3	46.8	32.3	23.8	59.8	42.5	24.1	22.2	68.9	55.8	24.7	22.3	25.2	22.5	21.8	22.1	25.1	22.5	46.9	34.4	23.3	22.0	63.1	50.3	24.2	22.1	64.9	59.8	24.8	22.1	43.6
04/17/93	04:00	323.3	46.9	32.7	23.4	60.0	43.1	24.1	22.1	69.5	56.5	24.8	22.3	25.4	22.5	21.7	22.0	25.2	22.4	46.9	34.7	23.2	22.0	63.9	50.8	24.2	22.0	66.1	60.5	24.8	22.0	44.5
04/17/93	08:00	327.3	47.0	33.1	23.4	60.2	43.7	24.2	22.2	69.5	57.4	24.8	22.3	25.0	22.5	21.7	21.9	25.4	22.5	47.0	35.1	23.4	22.0	64.1	51.7	24.3	22.1	66.1	61.6	24.9	21.9	45.4
04/17/93	12:00	331.3	47.0	33.3	23.5	60.1	44.0	24.1	22.1	69.4	57.9	24.7	22.2	25.6	22.4	21.6	22.0	25.4	22.4	46.8	35.2	23.2	21.9	64.0	52.4	24.1	22.0	66.1	62.1	24.8	21.9	45.5
04/17/93	16:00	335.3	47.0	33.4	23.1	59.9	44.6	24.0	21.9	69.4	58.7	24.9	22.1	25.8	22.5	21.5	21.7	25.5	22.1	46.8	34.9	23.2	21.8	64.0	52.8	24.2	21.9	66.0	63.2	24.9	21.6	46.0
04/17/93	20:00	339.3	47.0	34.1	23.7	59.9	45.3	24.2	22.2	68.4	59.2	24.8	22.3	26.4	22.4	21.7	22.0	26.1	22.6	47.3	35.9	23.3	22.0	62.8	54.3	24.1	22.0	64.4	64.4	24.8	21.9	45.5
04/18/93	00:00	343.3	47.3	34.7	23.7	60.3	46.1	24.3	22.2	69.0	60.1	25.0	22.3	26.6	22.5	21.6	22.1	26.3	22.6	47.5	36.3	23.5	22.0	63.6	55.0	24.4	22.1	65.5	65.2	25.0	22.0	46.9
04/18/93	04:00	347.3	47.3	35.1	23.6	60.3	46.6	24.4	22.2	69.0	60.5	25.0	22.3	26.9	22.6	21.8	22.0	26.5	22.7	47.3	36.7	23.6	22.0	63.5	55.7	24.4	22.0	64.8	65.8	25.2	22.0	47.0
04/18/93	08:00	351.3	47.4	35.5	23.7	60.4	47.2	24.5	22.2	68.7	61.2	25.2	22.3	27.1	22.7	21.7	21.9	26.7	22.7	47.1	37.1	23.7	22.1	63.6	56.3	24.6	22.1	64.8	66.4	25.4	22.0	48.5
04/18/93	12:00	355.3	47.2	35.5	23.2	59.9	47.5	24.3	22.1	68.5	61.7	25.2	22.1	27.0	22.8	21.7	21.7	26.7	22.4	46.9	36.8	23.8	22.0	63.6	56.2	24.8	22.2	64.9	66.6	25.4	21.9	48.7
04/18/93	16:00	359.3	47.5	36.0	23.4	60.3	47.9	24.2	22.0	68.9	62.1	25.0	22.1	27.3	22.6	21.5	21.8	26.8	22.4	47.5	37.5	23.5	21.9	64.0	57.0	24.5	21.9	65.4	67.7	25.3	21.8	49.5
04/18/93	20:00	363.3	48.0	36.7	24.0	61.2	48.6	24.5	22.3	69.4	62.9	25.2	22.4	28.0	22.7	21.7	22.2	27.5	23.0	48.6	38.6	23.7	22.1	64.6	58.3	24.6	22.1	65.9	69.9	25.4	22.0	50.4
04/19/93	00:00	367.3	48.2	37.2	23.6	61.6	49.4	24.6	22.3	70.0	63.9	25.3	22.5	28.3	22.7	21.8	22.2	27.7	22.9	48.5	38.9	23.8	22.2	65.2	59.0	24.8	22.2	66.5	71.2	25.6	22.2	50.9
04/19/93	04:00	371.3	48.3	37.4	23.7	61.7	49.9	24.6	22.2	70.5	64.6	25.4	22.4	28.4	22.9	21.7	22.1	27.8	22.8	48.4	39.2	23.8	22.0	65.2	59.6	24.9	22.2	66.5	72.3	25.7	22.0	50.4
04/19/93	08:00	375.3	48.4	37.8	23.7	62.0	50.5	24.7	22.3	70.8	65.3	25.5	22.4	28.7	22.9	21.8	22.1	28.0	22.8	48.7	39.6	24.0	22.1	65.5	60.3	25.0	22.1	66.6	73.4	25.8	22.1	51.1

Table B-4 Ground Electrode and Outside Thermowell Temperatures (Recorded by Data Logger) [Continued]

Date	Time	Elapsed Time	A2A	A2B	A2C	A3A	A3B	A3C	A3D	A4A	A4B	A4C	A4D	TW7B	TW7C	TW7D	C8D	C1B	C1C	C2A	C2B	C2C	C2D	C3A	C3B	C3C	C3D	C4A	C4B	C4C	C4D	C8B
	Maximum Temp.--		79.5	84.2	42.3	88.3	95.5	45.4	32.0	112.2	96.6	48.7	33.9	62.0	38.7	27.7	30.5	68.4	42.6	82.0	84.7	48.7	31.9	96.3	98.5	62.0	32.7	92.1	98.3	49.4	31.9	90.1
04/19/93	12.00	379.3	48.4	37.8	23.4	61.8	51.0	24.5	22.1	70.7	65.9	25.8	22.2	28.8	23.0	21.7	21.9	28.1	22.5	48.4	39.3	24.1	22.1	65.5	60.4	25.1	22.2	66.5	73.8	25.9	21.9	51.1
04/19/93	16.00	383.3	48.8	38.3	23.5	62.0	51.4	24.5	22.1	70.7	66.3	25.4	22.3	28.9	22.8	21.5	21.8	28.2	22.5	48.8	39.8	23.9	21.9	65.4	61.1	24.8	22.0	66.7	74.8	25.7	21.8	51.8
04/19/93	20.00	387.3	49.2	39.1	24.1	62.9	52.1	24.8	22.3	71.5	66.8	25.3	22.4	29.5	22.7	21.5	22.2	28.9	23.1	50.0	41.2	23.9	22.1	66.2	62.4	24.8	22.0	67.4	76.1	25.7	22.0	52.4
04/20/93	00.00	391.3	49.4	39.5	23.9	63.3	52.9	24.8	22.4	72.2	67.9	25.7	22.6	29.8	23.0	22.0	22.3	29.0	23.0	49.8	41.5	24.2	22.2	66.8	63.0	25.3	22.3	67.8	77.1	26.1	22.3	51.3
04/20/93	04:00	395.3	49.5	39.8	23.9	63.5	53.5	24.8	22.2	71.9	68.6	25.7	22.5	30.1	23.1	21.8	22.2	29.2	23.0	50.0	41.8	24.1	22.2	66.6	63.6	25.2	22.2	67.4	77.8	26.1	22.2	52.7
04/20/93	08:00	399.3	49.7	40.4	24.0	63.7	54.1	24.9	22.3	72.4	69.3	25.8	22.5	30.5	23.1	21.9	22.1	29.5	23.0	50.6	42.4	24.3	22.2	66.8	64.3	25.4	22.3	67.4	78.7	26.4	22.1	53.1
04/20/93	12:00	403.3	50.0	40.9	24.1	63.9	54.9	25.1	22.5	72.8	70.2	26.1	22.6	30.8	23.5	22.1	22.3	29.9	23.1	50.6	42.9	24.5	22.3	67.1	65.1	25.8	22.5	68.0	79.4	26.7	22.3	54.5
04/20/93	16.00	407.3	49.6	40.9	23.9	63.4	55.2	24.9	22.3	72.4	70.5	25.9	22.5	30.8	23.3	21.8	22.1	29.7	22.8	50.1	42.9	24.2	22.0	66.1	65.3	25.5	22.2	66.4	79.9	26.5	22.1	54.3
04/20/93	20.00	411.3	50.3	41.7	24.3	64.2	55.7	24.9	22.4	72.7	71.0	25.8	22.7	31.3	23.2	21.9	22.4	30.3	23.3	50.8	43.9	24.3	22.4	67.0	66.5	25.4	22.4	67.2	80.7	26.5	22.4	54.2
04/21/93	00:00	415.3	50.2	42.3	24.4	64.1	56.5	25.2	22.5	72.7	71.6	26.1	22.7	31.8	23.3	21.9	22.5	30.8	23.4	51.0	44.5	24.5	22.3	66.3	67.4	25.8	22.4	66.4	80.9	26.8	22.4	52.6
04/21/93	04:00	419.3	50.3	42.8	24.4	64.2	57.2	25.2	22.5	73.2	72.2	26.2	22.8	32.2	23.5	22.0	22.4	31.0	23.4	51.7	45.0	24.6	22.4	66.7	68.0	25.9	22.5	66.8	80.8	26.9	22.5	54.5
04/21/93	08 00	423.3	50.2	43.1	24.3	64.1	57.7	25.4	22.5	73.3	72.9	26.4	22.8	32.4	23.5	21.9	22.3	31.3	23.4	51.7	45.3	24.8	22.5	66.6	68.5	26.2	22.6	66.4	81.4	27.1	22.5	54.4
04/21/93	12.00	427.3	49.8	43.0	23.8	63.3	57.9	25.0	22.3	72.5	73.2	26.1	22.5	32.4	23.4	21.9	22.2	31.1	23.0	51.3	45.2	24.5	22.2	65.6	68.6	26.0	22.4	70.0	80.4	27.0	22.3	54.3
04/21/93	16 00	431.3	49.6	43.2	24.0	62.2	58.2	25.2	22.3	71.1	73.0	26.2	22.6	32.6	23.5	21.8	22.2	31.2	23.0	50.5	45.7	24.5	22.1	64.5	69.0	25.9	22.3	64.3	81.0	27.1	22.1	52.0
04/21/93	20:00	435.3	50.2	44.1	24.3	63.0	58.8	25.1	22.5	72.3	73.5	26.1	22.6	33.2	23.2	21.8	22.4	31.7	23.3	51.2	46.7	24.5	22.3	66.3	69.9	25.8	22.4	66.2	81.4	27.1	22.3	55.7
04/22/93	00 00	439.3	50.5	44.7	24.6	63.2	59.6	25.5	22.5	72.8	74.2	26.4	22.8	33.8	23.5	21.9	22.5	32.3	23.5	52.6	47.2	24.9	22.3	66.6	70.5	26.3	22.4	66.5	82.3	27.5	22.4	56.5
04/22/93	04.00	443.3	50.5	45.1	24.5	63.2	60.0	25.5	22.5	73.2	74.9	26.5	22.7	34.0	23.5	21.8	22.4	32.4	23.5	52.8	47.6	24.9	22.3	66.7	70.9	26.4	22.4	67.0	82.2	27.6	22.4	55.8
04/22/93	08 00	447.3	50.8	45.7	24.6	63.3	60.8	25.7	22.6	73.6	75.8	26.8	22.8	34.3	23.8	21.9	22.3	33.0	23.6	53.3	47.9	25.2	22.6	67.3	71.6	26.7	22.7	67.8	82.8	27.9	22.4	55.8
04/22/93	12.00	451.3	50.5	45.5	24.3	62.9	61.0	25.6	22.4	73.0	76.0	26.7	22.6	34.1	23.9	22.0	22.2	32.7	23.3	52.8	47.6	25.1	22.3	67.1	71.8	26.7	22.6	67.2	84.2	27.8	22.4	57.5
04/22/93	16 00	455.3	50.2	45.7	24.3	61.9	61.3	25.4	22.3	72.5	76.0	26.5	22.6	34.4	23.5	21.6	22.2	32.9	23.1	51.8	47.9	24.8	22.1	66.6	72.3	26.4	22.3	65.5	83.8	27.0	22.1	51.0
04/22/93	20 00	459.3	50.5	46.4	24.6	62.5	61.7	25.5	22.4	73.4	75.5	26.4	22.7	35.0	23.5	21.6	22.4	33.2	23.6	52.4	48.7	25.0	22.2	67.2	73.1	26.4	22.3	67.1	84.0	27.7	22.2	56.9
04/23/93	00.00	463.3	51.0	47.1	24.7	63.1	62.6	25.7	22.5	73.7	76.6	26.8	22.8	35.6	23.8	21.8	22.5	33.8	23.8	53.9	49.3	25.3	22.3	68.0	73.7	26.9	22.5	67.5	84.7	28.3	22.5	57.6
04/23/93	04 00	467.3	51.3	47.4	24.8	63.5	63.1	25.8	22.5	74.0	77.2	26.9	22.8	35.9	23.9	21.8	22.5	34.2	23.8	54.1	49.7	25.4	22.4	69.5	74.0	26.9	22.6	68.1	85.8	28.7	22.5	57.6
04/23/93	08 00	471.3	51.4	48.0	24.8	63.6	63.7	25.9	22.7	74.6	78.0	27.2	23.0	36.2	24.2	22.0	22.4	34.5	23.9	55.0	50.1	25.8	22.6	70.7	74.7	27.3	22.8	68.9	86.2	28.7	22.6	58.9
04/23/93	12 00	475.3	51.3	47.8	24.3	63.3	63.8	25.7	22.3	74.4	78.3	27.1	22.6	36.0	24.0	21.8	22.1	34.2	23.5	54.2	49.7	25.6	22.3	69.0	74.4	27.2	22.5	68.6	86.3	28.7	22.3	58.9
04/23/93	16.00	479.3	51.4	48.2	24.5	63.8	64.2	25.7	22.4	74.5	78.5	27.0	22.7	36.5	23.9	21.7	22.2	34.6	23.5	54.1	50.4	25.6	22.2	69.0	75.0	27.1	22.4	68.9	86.7	28.6	22.3	59.9
04/23/93	20:00	483.3	51.9	49.0	25.1	64.6	65.0	25.9	22.6	75.2	79.1	27.0	22.9	37.0	23.8	21.8	22.4	35.0	24.0	55.4	51.4	25.9	22.5	70.0	75.9	27.1	22.5	69.7	87.9	28.5	22.5	60.8
04/24/93	00 00	487.3	52.2	49.6	25.1	64.7	65.7	26.1	22.7	75.7	79.6	27.3	23.0	37.6	24.2	22.0	22.6	35.6	24.1	56.2	51.9	26.0	22.6	70.5	76.5	27.6	22.7	70.4	88.1	29.2	22.7	59.7
04/24/93	04 00	491.3	53.5	49.9	25.0	64.8	66.1	26.2	22.8	75.7	80.1	27.5	23.0	37.9	24.4	22.1	22.7	35.8	24.1	56.1	52.1	26.1	22.5	71.0	76.8	27.8	22.7	70.6	88.4	29.4	22.7	61.3
04/24/93	08 00	495.3	52.7	50.3	25.0	65.0	66.5	26.2	22.6	76.1	80.4	27.4	22.9	38.1	24.3	22.0	22.5	36.0	24.0	56.6	52.6	26.1	22.4	71.2	77.1	27.8	22.7	71.2	89.2	29.5	22.6	61.9
04/24/93	12 00	499.3	52.7	50.6	25.1	65.1	66.9	26.2	22.7	76.8	81.0	27.4	23.1	38.2	24.5	22.0	22.6	36.2	24.1	56.5	52.8	26.2	22.5	71.3	77.4	27.9	22.9	71.4	89.8	29.6	22.7	61.6
04/24/93	16 00		52.7	50.9	24.9	64.8	67.4	26.1	22.5	76.4	81.2	27.5	22.9	38.2	24.3		22.4	36.3	23.8	55.5	53.1	25.9	22.2	70.8	77.3	27.8	22.5	72.5	90.2		22.4	64.6

Table B-4 Ground Electrode and Outside Thermowell Temperatures
(Recorded by Data Logger) [Continued]

Date	Time	Elapsed Time	A2A	A2B	A2C	A3A	A3B	A3C	A3D	A4A	A4B	A4C	A4D	TW7B	TW7C	TW7D	C6D
	Maximum Temp.--		79.5	84.2	42.3	86.3	95.5	45.4	32.0	112.2	96.6	48.7	33.9	62.0	38.7	27.7	30.5
04/24/93	20:00	507.3	54.2	51.4	25.4	65.5	67.9	26.3	22.7	77.9	81.5	27.6	23.0	38.9	24.2	21.8	22.6
04/25/93	00:00	511.3	54.4	52.0	25.3	65.2	68.5	26.5	22.8	78.5	82.1	27.7	23.2	39.3	24.6	22.2	22.6
04/25/93	04:00	515.3	54.0	52.4	25.2	65.5	69.0	26.5	22.6	78.4	82.4	27.6	23.2	39.6	24.5	22.2	22.6
04/25/93	08:00	519.3	54.2	52.7	25.2	65.8	69.4	26.5	22.8	79.4	82.7	27.9	23.2	39.9	24.6	22.2	22.7
04/25/93	12:00	523.3	53.7	52.8	25.1	70.2	68.3	26.5	22.6	78.6	82.8	28.0	22.9	39.8	24.7	21.9	22.5
04/25/93	16:00	527.3	54.5	53.3	25.3	65.3	69.9	26.5	22.6	79.9	82.9	28.0	23.1	40.2	24.8	21.9	22.6
04/25/93	20:00	531.3	55.9	54.0	25.7	65.7	70.6	26.8	22.8	80.7	83.4	28.1	23.2	40.9	24.9	22.0	22.8
04/26/93	00:00	535.3	55.4	54.6	25.7	65.3	71.2	26.9	22.9	80.8	84.2	28.3	23.4	41.3	25.0	22.3	23.1
04/26/93	04:00	539.3	56.4	55.0	25.9	65.9	71.3	27.1	22.9	81.2	84.5	28.5	23.4	41.6	25.1	22.3	23.0
04/26/93	08:00	543.3	57.6	55.4	25.9	65.8	72.1	27.2	23.0	81.8	85.0	28.7	23.3	42.0	25.3	22.2	22.9
04/26/93	12:00	547.3	56.7	55.2	25.8	71.0	69.3	27.0	22.8	82.2	84.9	28.4	23.1	41.8	25.4	22.2	22.8
04/26/93	16:00	551.3	56.2	55.5	25.5	65.4	72.4	27.0	22.7	83.2	85.0	28.5	23.1	41.9	25.2	21.8	22.7
04/26/93	20:00	555.3	57.6	56.2	25.9	66.8	73.1	27.2	22.8	84.2	85.6	28.4	23.2	42.5	25.0	21.9	22.8
04/27/93	00:00	559.3	58.7	56.9	26.1	67.5	73.7	27.3	22.8	83.9	86.0	28.8	23.3	43.1	25.3	22.1	22.9
04/27/93	04:00	563.3	59.9	57.3	26.1	68.6	74.0	27.4	23.0	84.7	86.7	29.1	23.4	43.4	25.6	22.2	23.1
04/27/93	08:00	567.3	58.9	57.7	26.0	66.9	74.8	27.5	22.9	86.0	87.0	29.1	23.4	43.7	25.7	22.2	23.0
04/27/93	12:00	571.3	59.5	57.9	26.0	66.9	75.0	27.4	22.8	86.1	87.2	29.1	23.3	43.9	25.7	22.2	23.0
04/27/93	16:00	575.3	59.8	58.1	26.1	67.4	75.4	27.5	22.9	88.4	87.0	29.1	23.4	43.9	25.9	22.2	23.0
04/27/93	20:00	579.3	60.3	58.9	26.3	67.9	76.0	27.6	23.1	89.7	87.4	29.3	23.4	44.5	25.7	22.3	23.2
04/28/93	00:00	583.3	61.0	59.2	26.4	67.6	76.3	27.8	23.0	88.6	87.5	29.5	23.5	44.8	26.0	22.2	23.1
04/28/93	04:00	587.3	61.0	59.6	26.4	70.3	75.1	27.8	23.0	89.4	88.0	29.5	23.5	45.1	26.1	22.2	23.1
04/28/93	08:00	591.3	61.8	60.0	26.6	67.9	77.2	28.0	23.1	90.8	88.2	29.7	23.6	45.4	26.2	22.3	23.2
04/28/93	12:00	595.3	61.1	60.3	26.5	73.5	75.6	28.0	23.2	91.4	88.2	29.7	23.7	45.5	26.2	22.5	23.2
04/28/93	16:00	599.3	61.9	60.7	26.5	71.7	77.3	28.0	23.2	91.8	88.8	29.8	23.7	45.9	26.3	22.4	23.3
04/28/93	20:00	603.3	61.7	61.2	26.7	72.7	77.7	28.1	23.2	92.8	89.0	29.8	23.7	46.2	26.3	22.3	23.4
04/29/93	00:00	607.3	63.5	61.6	26.9	71.4	78.4	28.3	23.2	93.8	89.7	30.1	23.8	46.6	26.6	22.6	23.4
04/29/93	04:00	611.3	63.3	62.0	26.9	72.0	78.4	28.3	23.2	94.3	89.7	30.0	23.6	46.8	26.6	22.4	23.3
04/29/93	08:00	615.3	63.2	62.2	27.0	72.5	78.6	28.2	23.0	94.8	89.7	30.0	23.5	47.0	26.5	22.2	23.3
04/29/93	12:00	619.3	62.8	62.8	27.0	70.5	80.1	28.5	23.2	94.5	90.2	30.4	23.6	48.4	26.8	22.6	23.5
04/29/93	16:00	623.3	64.2	62.8	26.9	69.6	80.3	28.4	23.1	93.1	90.3	30.1	23.6	48.4	29.6	22.3	23.3
04/29/93	20:00	627.3	63.9	63.1	27.0	70.9	80.6	28.5	23.1	88.9	91.4	30.3	23.6	48.5	29.0	22.3	23.2
04/30/93	00:00	631.3	63.6	63.7	27.1	70.3	81.2	28.6	23.2	86.6	91.9	30.3	23.7	48.6	28.6	22.2	23.4

Date	Time	C1B	C1C	C2A	C2B	C2C	C2D	C3A	C3B	C3C	C3D	C4A	C4B	C4C	C4D	C8B
	Maximum Temp.--	68.4	42.6	82.0	84.7	48.7	31.9	96.3	98.5	52.0	32.7	92.1	96.3	49.4	31.9	90.1
04/24/93	20:00	36.8	24.4	56.8	54.0	26.2	22.5	72.2	78.7	27.9	22.7	72.4	90.9	29.5	22.6	61.8
04/25/93	00:00	37.2	24.4	57.9	54.5	26.3	22.7	72.8	79.1	28.3	22.9	73.2	90.8	30.0	22.9	62.2
04/25/93	04:00	37.5	24.4	58.5	54.9	26.3	22.6	73.3	79.6	28.4	22.9	73.6	91.5	30.2	22.9	63.2
04/25/93	08:00	37.7	24.4	58.6	55.2	26.5	22.7	73.8	80.0	28.5	22.9	74.2	91.8	30.3	22.9	61.5
04/25/93	12:00	37.8	24.2	57.7	55.3	26.5	22.5	73.3	80.0	28.7	22.8	73.6	90.5	30.6	22.7	58.0
04/25/93	16:00	38.1	24.2	58.5	55.9	26.4	22.5	73.7	80.3	28.6	22.8	74.3	91.5	30.6	22.7	64.0
04/25/93	20:00	38.6	24.7	59.0	56.6	26.8	22.7	76.5	80.9	28.8	22.9	75.1	92.5	30.8	22.9	63.0
04/26/93	00:00	39.2	24.8	60.0	57.4	26.9	22.9	76.2	81.0	29.1	23.1	75.9	92.8	31.2	23.2	65.4
04/26/93	04:00	39.5	24.8	60.7	57.4	27.1	22.8	78.1	82.0	29.4	23.1	76.3	92.7	31.4	23.1	64.9
04/26/93	08:00	39.9	24.9	60.9	58.2	27.4	23.0	77.5	82.7	29.6	23.2	76.5	93.3	31.7	23.1	64.1
04/26/93	12:00	39.8	24.6	60.7	57.9	27.1	22.7	76.6	82.6	29.5	23.0	76.9	93.3	31.6	23.0	64.9
04/26/93	16:00	39.8	24.4	60.9	58.3	26.9	22.5	77.1	82.9	29.5	22.9	77.7	93.6	31.7	22.7	65.1
04/26/93	20:00	40.4	24.9	61.7	59.3	27.2	22.7	78.5	83.9	29.4	22.9	78.9	94.5	31.7	22.9	66.2
04/27/93	00:00	41.0	25.0	62.0	59.8	27.4	22.7	79.1	84.3	30.0	23.0	79.8	94.4	32.2	23.0	65.8
04/27/93	04:00	41.4	25.1	63.2	60.3	27.7	22.9	80.5	84.9	30.3	23.2	80.8	95.1	32.6	23.3	66.7
04/27/93	08:00	41.6	25.1	63.4	60.6	27.8	22.8	80.5	85.2	30.4	23.2	81.5	95.2	32.9	23.3	66.7
04/27/93	12:00	41.8	25.0	63.3	60.8	27.7	22.8	81.8	85.6	30.4	23.1	82.2	95.4	33.0	23.2	66.8
04/27/93	16:00	41.9	25.1	63.7	61.1	27.9	22.9	82.2	85.6	30.5	23.2	82.6	95.4	33.0	23.2	66.7
04/27/93	20:00	42.5	25.4	64.1	61.9	28.0	23.0	84.9	86.5	30.7	23.3	83.4	96.1	33.3	23.3	66.0
04/28/93	00:00	42.9	25.4	64.7	62.1	28.3	23.0	86.2	87.0	31.1	23.3	83.4	95.1	33.6	23.3	66.8
04/28/93	04:00	43.2	25.5	65.3	62.5	28.3	23.0	89.2	86.7	31.3	23.3	83.6	96.0	33.9	23.3	67.1
04/28/93	08:00	43.5	25.6	65.4	63.0	28.5	23.0	90.6	90.3	31.6	23.4	83.9	96.3	34.1	23.4	67.2
04/28/93	12:00	43.7	25.6	65.6	62.7	28.5	23.2	91.6	95.7	31.6	23.5	86.4	93.5	34.3	23.5	65.4
04/28/93	16:00	44.1	25.7	66.2	63.5	28.6	23.2	93.6	97.9	31.9	23.6	84.1	96.2	34.4	23.5	67.9
04/28/93	20:00	44.5	25.9	66.8	64.1	28.8	23.2	94.7	97.9	32.1	23.6	84.6	96.2	34.6	23.6	68.9
04/29/93	00:00	44.8	25.9	67.5	64.6	29.1	23.3	95.7	98.5	32.4	23.6	85.9	94.8	35.0	23.6	68.4
04/29/93	04:00	45.1	25.9	68.2	64.5	29.1	23.2	96.0	98.5	32.5	23.5	85.4	96.2	35.1	23.5	69.0
04/29/93	08:00	45.3	26.0	68.5	65.2	29.1	23.0	96.3	98.0	32.5	23.4	86.1	96.0	35.2	23.4	69.2
04/29/93	12:00	45.7	26.1	66.2	65.8	29.7	23.3	95.3	97.8	32.9	23.7	86.2	94.8	35.7	23.7	67.5
04/29/93	16:00	45.9	26.0	66.6	66.0	29.7	23.0	95.1	98.3	32.9	23.5	83.5	94.0	35.7	23.6	68.2
04/29/93	20:00	46.2	26.2	66.7	66.4	29.8	23.1	95.1	96.7	33.0	23.6	82.7	91.6	35.9	23.5	67.8
04/30/93	00:00	46.5	26.3	67.7	66.8	30.0	23.2	95.3	96.5	33.2	23.6	81.2	93.0	36.1	23.5	68.0

Table B-4 Ground Electrode and Outside Thermowell Temperatures
(Recorded by Data Logger) [Continued]

Date	Time	Elapsed Time	A2A	A2B	A2C	A3A	A3B	A3C	A3D	A4A	A4B	A4C	A4D	TW7B	TW7C	TW7D	C6D	C1B	C1C	C2A	C2B	C2C	C2D	C3A	C3B	C3C	C3D	C4A	C4B	C4C	C4D	C6B
	Maximum Temp.--		79.5	84.2	42.3	86.3	95.5	45.4	32.0	112.2	96.6	48.7	33.9	62.0	38.7	27.7	30.5	68.4	42.6	82.0	84.7	48.7	31.9	96.3	98.5	52.0	32.7	92.1	96.3	49.4	31.9	90.1
04/30/93	04:00	835.3	64.0	64.0	27.2	70.4	81.8	28.7	23.1	86.3	92.3	30.5	23.7	48.8	28.4	22.3	23.4	46.8	26.4	68.5	67.2	30.4	23.2	95.1	96.2	33.4	23.6	80.2	92.8	36.2	23.6	66.9
04/30/93	08:00	839.3	63.0	64.7	27.5	71.3	82.3	29.0	23.4	86.4	92.8	30.8	23.8	49.1	28.4	22.4	23.4	47.3	26.7	69.0	67.7	30.8	23.5	94.9	95.6	33.6	23.9	80.2	92.1	36.6	23.7	68.4
04/30/93	12:00	843.3	64.8	64.7	27.5	70.8	82.5	28.9	23.4	85.9	92.6	30.6	24.0	49.1	28.3	22.6	23.8	47.5	26.7	69.0	68.1	30.8	23.4	93.4	94.2	33.7	23.9	78.9	92.5	36.7	23.9	64.3
04/30/93	16:00	847.3	63.8	65.0	27.4	72.6	82.6	29.0	23.4	84.2	92.7	30.9	23.9	49.2	28.3	22.7	23.5	47.8	26.6	69.0	68.1	31.3	23.5	92.0	92.8	34.0	23.9	77.8	90.7	37.0	23.8	66.0
04/30/93	20:00	851.3	64.0	65.4	27.6	74.7	82.9	29.0	23.3	84.7	93.1	30.7	23.8	49.4	28.1	22.5	23.6	48.0	26.7	69.5	68.6	31.2	23.4	91.6	92.4	33.8	23.7	77.8	90.7	36.8	23.7	67.2
05/01/93	00:00	855.3	64.3	65.7	27.7	72.6	83.4	29.2	23.4	85.3	93.5	31.0	23.9	49.7	28.3	22.3	23.7	48.4	26.9	69.8	68.7	31.2	23.4	91.3	91.9	34.2	23.9	77.6	91.7	37.1	23.9	67.6
05/01/93	04:00	859.3	64.2	66.0	27.8	71.9	83.8	29.3	23.4	85.0	93.4	31.2	24.1	49.9	28.5	22.5	23.7	48.8	27.0	69.9	68.9	31.4	23.5	89.9	90.9	34.3	23.9	77.0	91.5	37.3	23.9	64.9
05/01/93	08:00	863.3	64.0	66.1	27.8	70.9	84.0	29.4	23.4	83.6	92.8	31.2	24.0	50.0	28.8	22.6	23.7	48.9	27.1	70.0	68.7	31.5	23.5	88.4	89.1	34.5	24.0	76.5	90.4	37.3	24.0	65.9
05/01/93	12:00	867.3	64.1	65.6	27.7	69.9	84.2	29.4	23.2	83.1	92.6	31.1	23.9	49.7	28.5	22.4	23.5	48.7	26.9	69.3	68.8	31.4	23.4	88.6	88.7	34.3	23.9	75.8	89.7	37.0	23.8	65.3
05/01/93	16:00	871.3	63.5	65.6	27.9	70.0	84.6	29.5	23.4	82.7	92.0	31.3	24.1	49.8	28.7	22.5	23.7	49.0	27.0	69.2	68.9	31.7	23.4	87.8	87.8	34.6	24.1	75.5	89.6	37.2	24.0	61.9
05/01/93	20:00	875.3	62.3	66.6	28.2	69.8	84.5	29.5	23.4	82.0	89.4	31.1	24.1	50.1	28.5	22.4	23.8	49.5	27.4	68.6	69.5	31.5	23.5	86.8	87.5	34.3	23.9	75.0	89.1	37.0	24.0	60.4
05/02/93	00:00	879.3	63.1	66.9	28.4	69.6	84.2	29.9	23.8	80.8	89.1	31.6	24.4	50.5	28.8	23.0	24.1	50.0	27.6	69.2	69.5	31.9	23.9	85.7	85.9	34.8	24.3	74.4	87.9	37.7	24.5	59.4
05/02/93	04:00	883.3	61.8	66.9	28.5	68.3	83.7	29.8	23.6	79.6	87.0	31.6	24.3	50.6	28.9	22.7	23.9	50.2	27.7	69.0	69.5	31.7	23.7	84.5	85.1	34.9	24.3	73.5	86.6	37.6	24.3	58.2
05/02/93	08:00	887.3	61.2	66.9	28.8	67.6	83.2	30.0	23.6	78.6	85.4	31.8	24.4	50.8	29.0	22.9	24.0	50.6	27.8	68.3	68.8	31.6	23.9	83.4	84.2	35.1	24.4	72.8	85.5	37.8	24.5	57.7
05/02/93	12:00	891.3	60.5	66.4	28.2	67.0	80.9	29.8	23.6	77.2	85.2	31.7	24.2	50.3	29.0	22.8	23.8	50.4	27.4	66.3	69.5	31.2	23.8	82.4	82.6	35.0	24.4	73.0	83.6	37.5	24.4	58.7
05/02/93	16:00	695.3	60.6	66.0	28.4	67.4	82.4	30.0	23.7	77.7	86.7	31.7	24.3	50.4	29.2	22.8	23.9	50.4	27.6	65.6	69.8	31.1	23.7	83.5	82.9	34.8	24.3	72.3	84.8	37.4	24.3	64.1
05/02/93	20:00	899.3	61.0	66.8	28.7	68.7	83.0	29.9	23.7	78.6	87.7	31.7	24.4	50.7	28.8	22.8	24.2	50.8	27.8	66.4	70.2	31.2	23.8	85.5	85.8	34.8	24.3	73.2	85.7	37.2	24.4	62.9
05/03/93	00:00	703.3	62.2	67.4	28.9	70.1	83.5	30.4	23.9	79.6	89.0	32.2	24.6	51.1	29.3	22.9	24.4	51.2	28.1	66.8	70.4	31.7	24.1	87.3	88.8	35.3	24.6	73.9	87.1	37.6	24.7	67.0
05/03/93	04:00	707.3	62.0	67.6	28.9	71.9	81.2	30.4	23.9	80.0	89.4	32.1	24.6	51.1	29.3	22.9	24.3	51.4	28.2	66.6	70.4	31.7	24.0	87.8	88.0	35.2	24.5	74.0	87.4	37.5	24.6	66.1
05/03/93	08:00	711.3	63.4	68.1	29.1	71.0	85.8	30.8	24.1	80.7	89.4	32.7	24.7	51.2	29.5	23.2	24.4	51.9	28.5	68.3	70.2	32.4	24.4	89.0	88.8	35.7	24.9	74.3	88.1	37.6	24.8	61.7
05/03/93	12:00	715.3	62.3	67.7	28.5	72.9	85.8	30.2	23.6	80.6	90.3	32.1	24.3	50.5	29.4	22.9	24.1	51.2	27.9	68.1	69.4	31.9	24.0	89.1	90.2	35.2	24.6	75.1	88.0	37.2	24.5	66.3
05/03/93	16:00	719.3	61.8	67.2	28.5	75.9	86.3	30.2	23.6	81.2	90.6	32.0	24.3	50.5	29.0	22.8	24.0	51.1	27.7	67.7	69.4	31.8	23.7	89.1	88.8	35.1	24.3	75.7	87.4	37.1	24.3	65.8
05/03/93	20:00	723.3	62.7	68.5	29.0	78.6	87.0	30.3	23.8	82.2	90.9	31.9	24.5	50.9	29.0	22.7	24.4	51.6	28.3	68.8	70.4	32.0	24.0	89.8	91.4	34.9	24.4	76.6	89.8	36.8	24.5	66.1
05/04/93	00:00	727.3	63.7	69.3	29.2	80.7	87.8	30.6	24.0	82.8	91.5	32.4	24.7	51.4	29.4	23.1	24.7	52.2	28.5	70.1	70.9	32.5	24.2	90.3	91.8	35.5	24.8	77.6	90.5	37.3	24.9	66.1
05/04/93	04:00	731.3	64.3	69.5	29.1	82.4	88.3	30.8	24.0	83.1	91.9	32.5	24.8	51.4	29.6	23.1	24.6	52.3	28.4	70.7	71.0	32.6	24.2	91.0	92.7	35.6	24.6	78.9	90.3	37.3	24.9	67.5
05/04/93	08:00	735.3	64.5	69.8	29.2	83.1	88.6	30.8	24.0	83.1	91.7	32.6	24.8	51.4	29.6	23.1	24.6	52.5	28.5	70.9	71.2	32.7	24.2	90.9	92.3	35.6	24.8	79.3	90.8	37.3	25.0	66.4
05/04/93	12:00	739.3	64.6	70.1	29.1	83.9	88.1	30.8	24.1	83.1	92.0	32.8	24.8	51.5	29.8	23.4	24.8	52.6	28.5	71.1	71.3	32.8	24.3	91.3	92.9	35.6	24.9	80.1	90.8	37.3	25.0	66.8
05/04/93	16:00	743.3	65.5	70.3	29.2	84.6	89.1	31.0	24.1	83.1	92.1	32.7	24.9	51.5	29.9	23.3	24.8	52.7	28.5	71.2	71.3	32.7	24.3	91.9	93.2	35.6	25.0	80.7	91.2	37.2	25.1	67.3
05/04/93	20:00	747.3	65.2	70.8	29.4	85.6	89.5	30.8	24.2	83.8	92.0	32.6	25.0	51.7	29.4	23.2	25.0	53.1	28.7	71.6	72.1	32.6	24.4	92.6	93.9	35.5	24.9	81.5	91.5	37.0	25.1	66.7
05/05/93	00:00	751.3	65.8	71.2	29.4	85.9	89.9	31.0	24.2	84.2	92.3	32.8	24.9	51.9	29.7	23.4	24.9	53.3	28.8	72.3	72.3	32.8	24.4	93.0	94.4	35.7	24.9	82.2	91.9	37.1	25.1	69.6
05/05/93	04:00	755.3	66.5	71.6	29.4	86.0	90.1	31.1	24.2	84.6	92.5	33.0	25.0	52.0	29.8	23.4	25.0	53.6	28.8	72.8	72.5	32.9	24.4	93.6	95.0	35.7	25.1	82.8	92.1	37.2	25.2	69.3
05/05/93	08:00	759.3	67.8	71.9	29.6	85.8	90.5	31.1	24.3	83.8	92.4	33.0	25.0	52.3	29.8	23.4	25.1	53.9	28.9	73.0	72.8	33.1	24.5	94.2	95.6	35.8	25.1	83.4	92.5	37.2	25.3	68.3

Table B-4 Ground Electrode and Outside Thermowell Temperatures (Recorded by Data Logger) [Continued]

Date	Time	Elapsed Time	A2A	A2B	A2C	A3A	A3B	A3C	A3D	A4A	A4B	A4C	A4D	TW7B	TW7C	TW7D	C6D	C1B	C1C	C2A	C2B	C2C	C2D	C3A	C3B	C3C	C3D	C4A	C4B	C4C	C4D	C6B
	Maximum Temp.--		79.5	84.2	42.3	80.3	95.5	45.4	32.0	112.2	96.6	48.7	33.9	62.0	38.7	27.7	30.5	68.4	42.6	82.0	84.7	48.7	31.9	96.3	98.5	52.0	32.7	92.1	96.3	49.4	31.9	90.1
05/05/93	12:00	763.3	68.9	72.0	28.7	85.5	90.8	31.4	24.4	83.2	92.4	33.3	25.2	52.4	30.1	23.7	25.2	54.3	28.0	73.8	73.0	33.3	24.7	94.1	95.2	36.0	25.3	84.3	92.2	37.4	25.5	64.8
05/05/93	16:00	767.3	67.7	72.7	28.8	85.2	91.0	31.4	24.5	83.2	92.5	33.4	25.3	52.8	30.0	23.4	25.4	54.5	28.2	77.0	72.8	33.4	24.7	94.5	95.3	36.0	25.3	84.6	92.2	37.4	25.4	69.4
05/05/93	20:00	771.3	68.8	72.8	28.6	84.4	91.1	31.3	24.3	83.2	92.2	33.2	25.2	52.8	30.0	23.4	25.2	54.8	28.1	77.1	73.1	33.8	24.6	94.1	94.9	35.9	25.2	84.8	92.1	37.2	25.4	69.4
05/06/93	00.00	775.3	68.3	73.2	28.7	83.6	91.3	31.3	24.4	83.2	92.1	33.4	25.2	52.8	29.7	23.4	25.2	54.9	28.2	76.4	73.3	33.9	24.6	94.1	94.6	35.8	25.2	84.9	92.0	37.1	25.3	69.5
05/06/93	04.00	779.3	68.5	73.4	28.7	82.9	91.6	31.4	24.4	83.4	92.3	33.4	25.2	52.9	30.0	23.4	25.2	55.0	28.2	76.7	73.3	33.8	24.6	94.2	94.8	35.9	25.3	85.4	92.0	37.2	25.4	70.8
05/06/93	08.00	783.3	68.8	73.8	28.6	82.0	91.8	31.6	24.5	83.6	92.4	33.7	25.3	53.2	30.3	23.6	25.4	55.4	28.4	76.2	74.1	34.2	24.8	94.1	94.6	36.1	25.4	85.8	91.5	37.4	25.6	69.8
05/06/93	12.00	787.3	68.5	73.9	28.5	80.9	91.8	31.4	24.5	83.1	92.3	33.5	25.2	52.8	30.2	23.5	25.1	55.3	28.3	74.1	74.1	34.6	24.7	93.9	94.2	35.9	25.4	86.0	91.1	37.1	25.4	68.9
05/06/93	16:00	791.3	68.4	74.0	28.7	79.9	91.7	31.5	24.3	83.3	91.9	33.5	25.2	52.9	30.0	23.3	25.2	55.3	28.2	73.7	74.7	35.7	24.6	93.5	94.1	35.8	25.2	85.9	91.3	36.8	25.3	68.3
05/06/93	20.00	795.3	69.0	73.8	28.8	79.9	92.0	31.3	24.5	84.1	92.3	33.4	25.3	53.2	29.8	23.2	25.4	55.7	28.5	74.2	75.1	36.0	24.7	93.8	94.6	35.5	25.2	86.6	87.4	36.7	25.3	67.9
05/07/93	00:00	799.3	69.5	75.1	30.0	79.8	92.3	31.7	24.6	84.6	92.9	33.7	25.4	53.6	30.2	23.7	25.5	55.9	28.7	74.8	75.5	36.5	24.8	94.0	94.8	36.0	25.4	87.1	90.7	37.2	25.5	69.2
05/07/93	04 00	803.3	70.4	75.4	30.1	79.5	92.4	31.6	24.5	85.0	93.3	33.7	25.4	53.7	30.1	23.4	25.5	56.3	28.8	74.9	75.8	37.1	24.7	94.2	95.0	35.9	25.3	87.3	91.9	37.1	25.4	71.0
05/07/93	08.00	807.3	70.8	75.3	30.1	79.3	92.5	31.9	24.7	85.4	93.9	34.0	25.4	53.8	30.4	23.7	25.6	56.7	28.9	75.5	75.9	37.1	24.9	94.2	94.8	36.2	25.5	87.6	90.9	37.3	25.6	69.9
05/07/93	12.00	811.3	70.0	75.9	30.0	79.0	92.8	31.9	24.7	85.4	94.2	34.0	25.5	53.7	30.5	23.7	25.6	56.8	28.9	75.1	75.5	37.6	25.1	94.2	94.6	36.3	25.7	87.8	91.0	37.3	25.7	71.6
05/07/93	16.00	815.3	70.2	76.1	30.2	78.9	92.5	31.8	24.6	85.7	94.1	33.8	25.6	54.0	30.2	23.5	25.7	56.9	30.0	75.2	76.0	37.0	25.0	94.0	94.5	36.1	25.5	87.9	91.6	37.0	25.6	70.4
05/07/93	20.00	819.3	70.6	76.6	30.3	78.8	92.7	31.9	24.8	86.1	94.5	34.1	25.6	54.2	30.3	23.7	25.7	57.3	30.0	75.6	76.4	37.1	25.0	94.1	94.8	36.3	25.6	88.3	92.0	37.2	25.7	72.5
05/08/93	00:00	823.3	71.8	76.4	30.3	78.8	92.8	32.0	24.7	86.2	94.6	34.2	25.5	54.3	30.3	23.7	25.7	57.5	30.0	75.9	76.5	36.6	25.0	94.1	94.7	36.3	25.5	88.6	91.2	37.3	25.6	72.3
05/08/93	04 00	827.3	71.0	77.1	30.4	78.7	93.1	32.1	24.7	86.5	95.0	34.3	25.6	54.5	30.4	23.7	25.8	57.7	30.1	76.4	76.7	37.3	25.1	94.3	95.1	36.4	25.5	88.9	92.3	37.3	25.6	73.0
05/08/93	08.00	831.3	71.0	77.2	30.5	78.0	92.8	32.3	24.8	86.3	94.6	34.5	25.7	54.6	30.4	23.8	25.8	58.0	30.1	76.4	76.8	36.9	25.1	93.7	94.4	36.6	25.8	88.4	91.8	37.5	25.8	68.0
05/08/93	12:00	835.3	70.6	77.0	30.3	76.6	91.8	32.2	24.8	84.6	93.4	34.4	25.7	54.4	30.5	23.8	25.7	58.0	30.1	76.4	76.4	36.5	25.2	92.0	92.3	36.4	25.8	87.6	90.4	37.3	25.8	66.7
05/08/93	16.00	839.3	70.4	77.1	30.6	76.5	92.0	32.3	24.8	84.2	93.3	34.4	25.7	54.5	30.5	23.7	25.7	58.1	30.2	76.5	76.6	36.4	25.1	92.1	92.7	36.3	25.7	87.7	90.6	37.2	25.7	69.4
05/08/93	20.00	843.3	70.8	77.5	30.7	77.3	92.5	32.4	25.1	84.7	93.8	34.6	25.9	54.9	30.5	23.9	26.0	58.6	30.3	76.7	77.2	37.0	25.3	93.1	93.8	36.5	25.8	88.3	91.1	37.3	26.0	72.0
05/09/93	00:00	847.3	71.5	77.1	30.7	77.5	92.8	32.6	25.0	85.0	93.9	34.7	25.8	55.1	30.6	24.1	26.0	58.8	30.4	77.1	77.1	36.8	25.3	93.5	94.2	36.8	25.8	88.7	89.1	37.6	25.9	72.3
05/09/93	04 00	851.3	71.8	78.1	30.7	77.4	93.0	32.6	24.9	85.5	94.1	34.9	25.8	55.2	30.6	23.8	25.9	58.9	30.4	77.4	77.4	36.6	25.3	93.8	94.6	36.8	25.8	89.1	91.8	37.6	25.8	71.1
05/09/93	08 00	855.3	72.0	78.3	30.9	77.9	93.0	32.8	25.1	85.9	94.3	35.0	25.9	55.3	30.8	24.1	26.0	59.2	30.5	78.7	77.5	36.5	25.4	93.8	94.5	37.0	25.9	89.3	91.7	37.8	26.0	70.7
05/09/93	12:00	859.3	72.0	78.3	30.7	77.6	93.2	32.6	25.0	86.0	94.3	35.0	26.0	55.2	30.6	23.9	26.1	59.2	30.4	78.0	77.4	36.2	25.4	93.9	94.4	36.8	26.0	89.7	91.2	37.6	26.0	73.0
05/09/93	16 00	863.3	71.8	78.6	30.8	77.9	93.1	32.7	24.9	85.9	94.3	35.0	25.9	55.1	30.6	23.7	25.9	59.2	30.5	78.3	77.5	36.1	25.2	93.7	94.2	36.7	25.8	89.7	91.7	37.4	25.7	71.8
05/09/93	20:00	867.3	72.3	79.0	31.0	78.4	93.3	32.7	25.1	86.4	94.4	35.0	26.0	55.4	30.8	23.8	26.2	59.6	30.8	78.4	78.0	36.1	25.4	94.1	94.5	36.7	25.9	90.1	91.2	37.5	25.9	73.4
05/10/93	00 00	871.3	73.0	79.3	31.3	79.6	93.5	33.2	25.3	86.9	94.9	35.5	26.2	55.9	30.9	24.2	26.4	60.1	30.9	79.3	78.5	36.3	25.6	94.5	94.9	37.2	26.1	90.5	89.3	38.0	26.2	77.5
05/10/93	04.00	875.3	74.5	79.1	31.3	79.7	93.9	33.2	25.3	87.1	95.1	35.7	26.2	56.0	30.9	24.1	26.4	60.3	30.9	80.1	78.7	36.2	25.6	94.9	94.5	37.2	26.2	90.9	92.7	38.1	26.2	74.4
05/10/93	08.00	879.3	73.9	78.7	31.4	80.5	93.6	33.4	25.4	87.1	95.1	36.0	26.2	56.1	31.0	24.2	26.1	60.7	31.0	81.0	78.9	36.3	25.8	94.8	94.9	37.5	26.3	90.9	84.5	38.2	26.2	71.8
05/10/93	12:00	883.3	73.7	79.8	30.8	81.1	93.7	33.1	25.2	87.1	95.2	35.7	26.1	55.7	30.9	24.0	26.1	60.3	30.5	80.6	78.6	35.7	25.5	95.0	94.6	37.2	26.1	90.3	87.5	38.0	26.1	78.0
05/10/93	16.00	887.3	73.5	79.7	31.2	80.3	93.8	33.1	25.2	87.4	95.0	35.7	26.2	55.8	31.0	24.0	26.2	60.4	30.8	79.5	78.7	35.5	25.4	94.7	94.8	37.1	26.0	90.8	91.8	38.0	26.1	77.3

Table B-4 Ground Electrode and Outside Thermowell Temperatures
(Recorded by Data Logger) [Continued]

Date	Time	Elapsed Time	A2A	A2B	A2C	A3A	A3B	A3C	A3D	A4A	A4B	A4C	A4D	TW7B	TW7C	TW7D	C6D	C1B	C1C	C2A	C2B	C2C	C2D	C3A	C3B	C3C	C3D	C4A	C4B	C4C	C4D	C6B
Maximum Temp.--			79.5	84.2	42.3	88.3	95.5	45.4	32.0	112.2	96.8	48.7	33.9	62.0	38.7	27.7	30.5	68.4	42.8	82.0	84.7	48.7	31.9	96.3	98.5	52.0	32.7	92.1	96.3	49.4	31.9	90.1
05/10/93	20:00	891.3	73.5	79.8	31.3	80.7	83.9	33.0	25.1	87.4	94.8	35.8	26.1	56.0	30.4	23.7	26.2	60.7	30.7	80.1	79.0	35.5	25.4	95.0	95.3	36.9	25.9	91.1	93.0	37.7	25.9	75.6
05/11/93	00.00	895.3	74.1	80.9	31.5	81.8	94.1	33.6	25.4	87.8	95.1	36.1	26.3	56.5	30.9	24.0	26.4	61.2	31.1	81.3	79.5	36.0	25.7	95.4	95.6	37.4	26.2	91.7	93.1	38.3	26.2	74.6
05/11/93	04:00	899.3	73.5	80.7	31.7	82.0	94.5	33.7	25.4	88.3	95.5	36.5	26.5	56.8	31.1	24.2	26.6	61.5	31.2	82.0	79.7	36.1	25.8	95.9	95.4	37.7	26.3	92.1	93.6	38.5	26.3	76.5
05/11/93	08:00	903.3	75.9	81.0	31.8	81.9	94.4	34.1	25.7	87.9	95.4	36.8	26.6	56.8	31.4	24.3	26.4	62.0	31.4	82.0	79.8	36.5	26.0	95.3	94.7	38.0	26.7	91.8	92.9	38.8	26.4	72.0
05/11/93	12:00	907.3	75.1	80.8	31.2	81.6	92.4	33.6	25.3	86.9	95.0	36.4	26.2	56.2	31.2	24.1	26.2	61.4	30.9	81.0	79.1	35.8	25.6	95.0	94.4	37.6	26.3	91.5	92.2	38.4	26.2	74.3
05/11/93	16:00	911.3	74.7	81.0	31.5	82.4	92.6	33.8	25.3	87.2	95.1	36.6	26.4	56.4	31.1	24.0	26.3	61.5	30.9	80.7	79.2	35.8	25.5	95.0	94.8	37.5	26.2	91.3	92.6	38.4	26.2	75.3
05/11/93	20:00	915.3	74.4	80.7	31.7	80.4	92.8	33.5	25.3	85.8	93.0	36.2	26.4	56.7	30.5	23.6	26.2	61.8	31.1	80.5	79.6	35.6	25.6	93.0	93.0	37.2	26.1	89.2	91.3	38.1	26.1	68.5
05/12/93	00 00	919.3	73.8	80.6	32.0	80.4	91.9	34.0	25.5	84.4	92.1	36.8	26.6	57.2	30.9	24.0	26.4	62.3	31.4	80.7	79.4	36.1	25.8	92.0	92.0	37.8	26.4	88.0	90.1	38.8	26.4	63.2
05/12/93	04:00	923.3	73.3	80.2	32.1	79.4	90.5	34.2	25.6	83.1	91.2	36.9	26.8	57.3	31.3	24.3	26.4	62.5	31.5	77.3	80.2	36.1	25.9	90.9	91.0	38.0	26.5	88.9	89.1	39.0	26.6	64.9
05/12/93	08.00	927.3	73.8	80.2	32.2	79.8	91.0	34.5	25.9	83.1	92.1	37.4	26.8	57.3	31.6	24.4	26.4	62.8	31.6	76.3	80.0	36.4	26.2	91.8	91.4	38.5	26.8	87.7	89.5	39.2	26.6	73.2
05/12/93	12:00	931.3	73.7	79.9	31.7	78.8	91.9	34.1	25.5	82.8	92.2	37.0	26.5	56.9	31.4	24.2	26.5	62.3	31.0	74.4	79.4	35.8	25.8	92.4	92.1	38.1	26.5	87.7	89.9	38.9	26.5	73.5
05/12/93	16:00	935.3	73.9	80.1	32.1	79.6	92.5	34.3	25.7	83.5	92.7	37.1	26.8	57.1	31.6	24.3	26.7	62.3	31.2	76.4	79.7	35.7	25.8	93.2	93.0	38.0	26.5	87.9	90.5	39.1	26.5	70.8
05/12/93	20:00	939.3	74.6	80.7	32.3	80.6	93.0	34.3	25.8	84.3	93.0	37.2	26.8	57.4	31.2	24.2	26.9	62.8	31.5	75.5	80.4	35.9	26.0	93.8	93.8	37.9	26.5	86.3	85.2	39.0	26.6	74.4
05/13/93	00.00	943.3	74.6	80.7	32.5	81.1	94.7	34.7	25.8	85.2	93.7	37.6	26.9	57.8	31.6	24.3	27.0	63.0	31.7	77.1	80.9	36.3	26.0	94.4	94.5	38.4	26.7	88.8	91.9	39.5	26.8	70.3
05/13/93	04:00	947.3	75.7	80.5	32.7	81.8	94.0	34.7	25.9	85.9	94.1	37.7	27.0	57.8	31.5	24.2	27.0	63.2	31.8	77.8	81.2	36.3	26.1	94.9	95.1	38.5	26.6	89.0	91.4	39.5	26.7	73.7
05/13/93	08:00	951.3	76.6	79.7	32.7	82.3	94.4	35.1	26.0	86.4	94.6	38.1	27.0	57.9	31.8	24.5	26.8	63.5	32.0	77.9	81.4	36.6	26.3	95.0	95.0	38.9	26.9	89.2	92.3	39.8	26.8	73.9
05/13/93	12:00	955.3	75.8	81.4	32.2	81.9	94.2	34.7	25.8	86.5	94.6	37.7	26.8	57.5	31.7	24.3	26.8	63.1	31.4	78.8	80.9	36.2	26.0	94.8	94.8	38.6	26.7	89.2	92.2	39.5	26.7	73.3
05/13/93	16 00	959.3	75.3	81.7	32.5	81.8	94.4	35.0	25.7	86.8	94.6	37.9	26.9	57.6	31.8	24.2	26.8	63.1	31.6	79.4	80.0	36.1	25.9	94.4	94.4	38.5	26.6	89.2	92.5	39.5	26.6	74.2
05/13/93	20 00	963.3	76.1	81.6	32.7	83.1	94.0	34.8	25.9	87.1	94.4	37.9	27.0	57.9	31.3	24.1	27.1	63.4	31.9	80.0	80.3	36.1	26.1	94.7	94.9	38.6	26.6	89.3	93.1	39.6	26.8	77.0
05/14/93	00:00	967.3	76.5	80.9	33.1	82.8	94.5	35.3	26.0	87.2	94.4	38.4	27.1	58.3	31.5	24.3	27.0	63.9	32.1	78.8	81.5	36.6	26.2	94.6	94.6	39.0	26.8	88.9	93.0	40.0	26.8	71.5
05/14/93	04.00	971.3	76.0	81.8	33.1	82.6	92.9	35.3	26.1	86.6	94.0	38.4	27.2	58.4	31.7	24.4	27.1	64.0	32.1	78.0	81.7	36.7	26.2	94.0	94.2	39.1	26.9	88.7	92.1	40.1	26.9	75.8
05/14/93	08 00	975.3	76.7	81.9	33.2	82.8	94.1	35.8	26.2	86.5	94.6	39.0	27.3	58.5	32.2	24.7	27.0	64.4	32.4	77.8	81.9	37.1	26.5	94.6	94.4	39.6	27.2	88.0	87.0	40.6	27.0	72.9
05/14/93	12 00	979.3	76.2	81.3	32.8	81.7	94.4	35.3	25.9	86.2	94.6	38.5	27.0	57.9	32.1	24.4	26.9	63.7	31.7	76.4	81.3	36.4	26.1	94.2	93.7	39.2	26.8	88.7	92.4	40.1	26.7	76.3
05/14/93	16 00	983.3	76.2	81.7	32.8	81.9	94.5	35.4	25.9	86.7	94.6	38.8	27.1	58.1	31.8	24.2	26.9	63.7	31.7	76.2	81.3	36.4	26.0	94.1	93.8	39.1	26.7	88.8	85.9	40.2	26.6	78.4
05/14/93	20 00	987.3	77.1	82.1	33.3	83.4	94.0	35.4	26.0	87.4	94.7	38.7	27.2	58.5	31.6	24.1	27.2	64.1	32.2	78.1	81.7	36.4	26.1	94.6	94.7	39.0	26.7	88.6	93.5	40.1	26.7	77.4
05/15/93	00 00	991.3	77.5	80.2	33.6	84.0	93.1	35.9	26.2	88.1	95.1	39.2	27.4	58.9	32.0	24.4	27.4	64.6	32.5	78.1	82.5	36.9	26.3	94.9	94.8	39.6	27.0	89.2	93.3	40.7	27.0	78.5
05/15/93	04:00	995.3	77.2	82.4	33.8	84.2	95.1	36.0	26.2	88.5	95.4	39.4	27.4	59.1	32.1	24.5	27.5	64.8	32.5	78.0	82.7	36.9	26.4	95.3	95.3	39.7	27.1	89.1	93.9	41.0	27.1	76.1
05/15/93	08 00	999.3	77.9	82.9	33.8	84.4	95.1	36.5	26.4	88.9	95.8	39.9	27.6	59.1	32.5	24.7	27.3	65.2	32.7	78.5	82.8	37.4	26.7	95.4	95.4	40.3	27.4	89.3	93.9	41.4	27.2	77.2
05/15/93	12:00	1003.3	77.2	80.9	33.3	84.2	95.0	36.1	26.2	88.5	95.5	39.6	27.3	58.7	32.1	24.4	27.2	64.6	32.2	77.4	82.1	37.0	26.3	95.1	94.7	39.9	27.1	88.6	93.2	41.1	27.0	74.6
05/15/93	16 00	1007.3	77.2	81.0	33.3	83.4	94.9	36.2	26.1	88.7	95.6	39.7	27.4	58.8	32.2	24.3	27.2	64.6	32.2	75.8	82.3	36.8	26.2	94.7	94.5	39.9	27.0	89.2	93.4	41.3	26.9	77.3
05/15/93	20:00	1011.3	77.5	83.0	34.0	84.9	95.2	36.2	26.3	89.2	95.6	39.6	27.5	59.2	32.0	24.3	27.6	65.1	32.7	77.1	83.0	36.8	26.4	95.3	95.2	39.8	26.9	89.5	88.9	41.1	27.0	80.1
05/16/93	00.00	[illegible]	78.4	83.0	34.1	85.5	95.5	36.6	26.5	89.7	96.0	40.2	27.7	59.7	32.3	[illegible]	27.7	65.5	32.9	78.3	83.4	37.3	26.5	95.6	95.4	40.4	27.2	89.8	94.8	[illegible]	27.3	79.6

Table B-4 Ground Electrode and Outside Thermowell Temperatures
(Recorded by Data Logger) [Continued]

Date	Time	Elapsed Time	A2A	A2B	A2C	A3A	A3B	A3C	A3D	A4A	A4B	A4C	A4D	TW7B	TW7C	TW7D	C6D	C1B	C1C	C2A	C2B	C2C	C2D	C3A	C3B	C3C	C3D	C4A	C4B	C4C	C4D	C6B
Maximum Temp.--			79.5	84.2	42.3	86.3	95.5	45.4	32.0	112.2	96.8	48.7	33.9	62.0	38.7	27.7	30.5	68.4	42.8	82.0	84.7	48.7	31.9	96.3	98.5	52.0	32.7	92.1	96.3	49.4	31.9	90.1
05/16/93	04:00	1019.3	78.5	83.4	34.3	85.4	95.4	36.9	26.5	90.0	96.3	40.4	27.8	59.9	32.5	24.7	27.8	65.7	32.9	78.8	83.6	37.5	26.6	95.7	95.6	40.6	27.3	90.2	94.1	42.0	27.4	78.9
05/16/93	08:00	1023.3	78.3	83.5	34.3	85.2	95.5	37.0	26.7	89.8	96.1	40.9	27.9	60.0	32.5	24.7	27.6	65.9	33.2	78.7	83.6	37.7	26.8	95.6	95.4	41.1	27.5	90.1	88.4	42.3	27.5	74.7
05/16/93	12:00	1027.3	78.2	83.1	34.0	84.8	94.9	36.9	26.4	88.8	95.8	40.7	27.6	59.4	32.8	24.7	27.5	65.6	32.8	78.1	83.0	37.5	26.6	95.0	94.6	41.0	27.4	89.7	93.7	42.2	27.4	81.8
05/16/93	16:00	1031.3	77.8	82.7	34.2	84.5	95.1	37.1	26.4	89.1	95.8	41.0	27.7	59.6	32.6	24.5	27.5	65.4	32.7	78.0	82.7	37.4	26.4	94.8	94.5	41.0	27.2	89.6	93.6	42.2	27.2	81.6
05/16/93	20:00	1035.3	78.5	81.8	34.6	85.5	95.2	37.1	26.6	89.5	95.8	40.9	27.9	60.0	32.5	24.4	27.9	66.0	33.2	78.7	83.5	37.5	26.6	95.2	95.2	40.9	27.3	89.8	87.7	42.2	27.4	83.8
05/17/93	00.00	1039.3	78.8	83.6	34.9	85.4	95.0	37.5	26.7	89.8	96.0	41.5	28.1	60.4	32.8	24.7	28.0	66.4	33.5	79.2	83.8	37.9	26.7	95.5	95.5	41.5	27.5	90.1	93.8	43.0	27.6	80.6
05/17/93	04:00	1043.3	79.2	82.0	35.0	85.9	95.5	37.7	26.7	89.9	96.2	41.8	28.1	60.5	33.0	24.9	28.1	66.4	33.4	79.3	83.7	38.1	26.7	95.5	95.4	41.8	27.6	90.2	95.0	43.3	27.7	81.9
05/17/93	08:00	1047.3	79.0	83.6	35.1	85.9	95.4	38.0	26.8	89.9	96.3	42.0	28.2	60.6	33.1	24.9	28.1	66.7	33.8	79.5	83.8	38.3	26.9	95.4	95.4	42.1	27.7	90.2	94.7	43.7	27.8	82.7
05/17/93	12:00	1051.3	78.4	83.8	35.0	85.5	95.3	37.9	26.8	89.5	96.2	42.1	28.1	60.4	33.2	24.9	28.0	66.5	33.4	78.9	83.3	38.3	27.0	95.3	95.1	42.2	27.8	90.0	93.3	43.7	27.7	84.3
05/17/93	16:00	1055.3	78.5	83.1	35.1	85.3	95.1	38.1	26.8	89.4	95.9	42.0	28.2	60.4	33.1	24.8	27.8	66.5	33.4	78.7	83.3	38.1	26.7	94.7	94.6	41.9	27.5	89.5	89.8	43.6	27.6	85.7
05/17/93	20.00	1059.3	78.9	83.5	35.3	85.9	93.8	38.0	26.9	89.7	95.7	42.2	28.3	60.8	32.8	24.7	28.1	66.8	33.8	79.5	83.5	38.3	26.8	95.2	95.4	42.2	27.6	89.7	94.6	43.7	27.7	87.9
05/18/93	00.00	1063.3	79.1	84.0	35.6	86.3	95.3	38.5	27.0	90.1	96.3	42.8	28.3	61.1	33.4	25.2	28.2	67.1	33.9	80.4	83.6	38.7	27.0	95.4	95.5	42.9	27.7	90.1	94.8	44.6	27.9	90.1
05/18/93	04:00	1067.3	79.4	84.2	35.7	85.9	95.4	38.6	27.0	90.1	96.3	43.0	28.4	61.1	33.4	24.9	28.2	67.2	34.0	79.6	84.0	38.8	27.0	95.6	95.7	43.0	27.8	90.4	94.8	44.7	27.9	89.4
05/18/93	08 00	1071.3	79.1	83.8	35.8	85.7	95.1	38.8	27.1	89.8	96.0	43.3	28.5	61.3	33.5	25.0	28.1	67.4	34.1	79.3	84.1	39.2	27.1	95.1	95.1	43.3	28.0	89.6	86.8	45.1	28.0	88.7
05/18/93	12:00	1075.3	79.5	83.9	36.5	85.6	95.3	39.1	27.3	89.9	96.2	43.4	28.6	61.5	33.6	25.0	28.4	67.8	34.5	79.7	84.7	39.3	27.2	95.5	95.7	43.5	27.9	90.2	93.5	45.1	28.1	87.7
05/18/93	16.00	1079.3	78.9	84.1	35.7	84.4	95.0	39.2	27.2	89.2	96.6	43.8	28.7	61.2	34.2	25.4	28.3	67.4	34.0	79.5	83.5	39.3	27.2	94.9	94.8	43.8	28.2	89.7	93.3	45.7	28.3	87.7
05/18/93	20:00	1083.3	78.6	84.0	36.3	84.9	93.0	39.0	27.2	88.6	95.2	43.5	28.7	61.4	33.3	25.0	28.3	67.6	34.3	78.9	84.0	39.2	27.1	94.3	94.5	43.5	28.0	88.6	92.9	45.4	28.2	85.1
05/19/93	00 00	1087.3	77.8	82.8	36.5	84.1	92.9	39.3	27.3	87.8	94.6	43.8	28.7	61.6	33.8	25.2	28.2	67.8	34.5	78.3	84.1	39.6	27.2	93.7	93.9	44.2	28.1	87.7	90.1	45.9	28.3	80.7
05/19/93	04:00	1091.3	77.9	82.8	36.7	83.2	92.9	39.6	27.5	87.1	94.0	44.1	28.9	61.8	34.1	25.3	28.3	68.0	34.7	77.9	83.8	39.8	27.3	93.5	93.7	44.4	28.3	87.1	91.3	46.2	28.5	81.7
05/19/93	08:00	1095.3	77.3	82.7	36.7	83.1	92.0	39.7	27.5	86.5	93.4	44.4	28.9	61.7	34.1	25.2	28.0	68.1	34.7	77.2	83.7	40.2	27.5	93.3	93.5	44.8	28.4	86.4	87.2	46.4	28.4	78.3
05/19/93	12:00	1099.3	76.7	82.1	36.4	82.3	92.5	39.5	27.4	85.9	92.9	44.2	28.7	61.3	34.2	25.2	28.0	67.7	34.3	77.2	80.6	40.0	27.4	93.0	93.0	44.9	28.3	85.0	89.1	46.4	28.3	82.9
05/19/93	16.00	1103.3	76.7	81.4	36.5	82.1	92.5	39.7	27.4	85.8	92.7	44.3	28.9	61.3	34.2	25.2	28.0	67.5	34.2	77.3	81.2	39.7	27.2	92.9	93.0	44.7	28.2	83.7	89.0	46.4	28.3	81.3
05/19/93	20.00	1107.3	76.4	81.5	36.9	81.9	92.5	39.8	27.5	85.9	92.5	44.4	29.0	61.6	34.1	25.1	28.3	67.7	34.7	76.9	80.9	40.1	27.5	93.3	93.6	44.9	28.3	82.9	89.6	46.6	28.5	81.4
05/20/93	00:00	1111.3	75.8	81.4	37.3	82.1	91.3	40.1	27.6	85.6	92.3	44.7	29.1	61.8	34.3	25.3	28.2	68.0	35.1	76.6	81.3	40.6	27.5	92.9	93.2	45.2	28.4	82.7	89.1	47.0	28.6	79.1
05/20/93	04:00	1115.3	75.5	81.3	37.3	81.8	91.9	40.3	27.7	85.3	92.4	44.9	29.3	61.9	34.6	25.3	28.3	68.1	35.2	76.4	81.0	40.8	27.5	92.7	93.0	45.4	28.6	82.3	89.3	47.2	28.7	77.2
05/20/93	08.00	1119.3	74.9	81.2	37.5	81.7	91.3	40.7	28.0	84.9	91.9	45.3	29.4	62.0	34.9	25.6	28.2	68.4	35.5	75.5	80.8	41.4	28.0	92.2	92.4	46.0	28.9	81.9	88.3	47.6	28.9	76.4
05/20/93	12:00	1123.3	73.4	79.8	36.7	79.7	90.1	39.8	27.4	83.8	90.5	44.4	28.9	61.2	34.3	25.0	27.8	67.4	34.6	74.5	79.7	40.5	27.3	90.8	91.2	45.3	28.4	80.3	87.2	46.8	28.5	78.4
05/20/93	16 00	1127.3	73.0	79.6	37.1	78.9	89.6	40.2	27.7	83.5	90.4	44.8	29.3	61.4	34.8	25.4	28.1	67.4	35.0	73.8	79.6	40.7	27.5	90.4	90.7	45.5	28.5	79.8	87.0	47.0	28.6	74.4
05/20/93	20 00	1131.3	72.5	79.5	37.6	79.7	89.3	40.3	27.9	83.5	90.2	44.7	29.4	61.6	34.5	25.3	28.3	67.7	35.3	73.7	79.9	40.9	27.7	90.3	90.9	45.6	28.6	81.4	86.9	47.1	28.7	79.9
05/21/93	00 00	1135.3	72.1	79.6	37.8	80.4	87.1	40.7	28.0	83.9	90.6	45.1	29.5	61.9	34.9	25.5	28.5	67.9	35.6	73.2	78.8	41.3	27.8	90.8	91.3	46.0	28.8	80.2	87.1	47.5	28.9	79.7
05/21/93	04 00	1139.3	71.6	79.3	37.9	79.8	87.6	40.8	28.1	83.6	90.6	45.2	29.6	61.8	35.1	25.5	28.5	67.9	35.7	72.3	79.6	41.4	27.9	90.8	91.3	46.3	28.9	80.3	86.7	47.6	29.0	75.4
05/21/93	08.00	1143.3	71.0	79.3	38.1	80.0	86.9	41.3	28.3	83.5	90.9	45.7	29.8	61.9	35.6	25.8	28.4	68.1	35.9	72.0	79.7	42.1	28.2	91.0	91.1	46.8	29.3	80.6	86.3	48.0	29.2	78.8

Table B-4 Ground Electrode and Outside Thermowell Temperatures
(Recorded by Data Logger) [Continued]

Date	Time	Elapsed Time	A2A	A2B	A2C	A3A	A3B	A3C	A3D	A4A	A4B	A4C	A4D	TW7B	TW7C	TW7D
Maximum Temp.--			78.5	84.2	42.3	88.3	85.5	45.4	32.0	112.2	90.6	48.7	33.8	62.0	38.7	27.7
05/21/93	12:00	1147.3	70.3	78.2	37.5	78.6	86.3	40.6	27.9	82.5	90.2	45.1	28.5	61.2	35.1	25.5
05/21/93	16:00	1151.3	70.1	77.8	37.7	78.2	85.9	40.8	28.1	82.4	90.4	45.2	28.8	61.3	35.4	25.6
05/21/93	20:00	1155.3	70.0	77.9	38.1	78.7	85.4	40.8	28.3	82.4	90.3	45.1	29.7	61.5	35.1	25.5
05/22/93	00:00	1159.3	69.7	77.8	38.4	78.8	85.7	41.3	28.4	82.1	90.3	45.5	29.8	61.7	35.6	25.8
05/22/93	04:00	1163.3	69.1	77.9	38.4	78.6	85.6	41.4	28.4	82.0	90.0	45.6	30.0	61.6	35.9	25.9
05/22/93	08:00	1167.3	69.1	78.1	38.6	78.8	86.7	41.6	28.5	82.3	90.1	45.8	30.1	61.6	35.9	26.0
05/22/93	12:00	1171.3	69.0	77.9	38.1	77.8	87.1	41.4	28.4	82.2	90.2	45.7	29.9	61.2	35.8	25.8
05/22/93	16:00	1175.3	69.1	77.9	38.4	77.7	87.5	41.3	28.5	82.4	90.0	45.7	30.0	61.2	35.7	25.7
05/22/93	20:00	1179.3	71.2	78.1	38.8	77.2	88.8	41.8	28.6	82.3	91.0	46.2	30.3	62.0	36.1	26.2
05/23/93	00:00	1183.3	70.9	78.4	38.9	78.1	89.1	42.0	28.7	82.0	89.9	46.3	30.4	62.0	36.3	26.1
05/23/93	04:00	1187.3	70.7	78.5	39.0	78.5	88.5	42.2	28.7	81.7	89.8	46.4	30.4	62.0	36.8	26.0
05/23/93	08:00	1191.3	71.7	78.5	39.2	79.2	88.2	42.4	28.8	81.2	89.1	46.7	30.5	61.9	37.7	26.2
05/23/93	12:00	1195.3	71.8	78.3	39.5	78.9	89.2	42.6	28.9	80.7	88.6	46.8	30.5	61.8	37.7	26.2
05/23/93	16:00	1199.3	71.8	77.6	39.8	78.8	89.4	42.8	28.9	80.5	88.4	47.0	30.7	61.8	37.8	26.3
05/23/93	20:00	1203.3	71.4	78.0	39.4	78.9	87.5	42.5	28.7	79.8	87.6	46.8	30.4	61.4	37.4	25.9
05/24/93	00:00	1207.3	71.9	78.5	39.7	78.7	89.2	42.9	29.0	79.9	87.8	47.1	30.7	61.6	37.5	26.2
05/24/93	04:00	1211.3	72.2	78.7	39.8	79.4	89.2	43.1	29.1	79.8	87.9	47.2	30.7	61.6	37.7	26.3
05/24/93	08:00	1215.3	72.1	78.4	39.9	79.8	88.4	43.1	29.1	79.3	87.4	47.3	30.9	61.5	37.7	26.3
05/24/93	12:00	1219.3	71.5	78.0	39.4	80.2	84.9	42.9	28.9	79.6	87.1	47.0	30.6	61.0	37.3	26.3
05/24/93	16:00	1223.3	71.0	77.5	39.3	79.7	87.4	42.7	28.9	80.0	86.5	46.8	30.7	60.8	37.1	26.1
05/24/93	20:00	1227.3	71.0	77.5	39.8	79.8	87.3	43.0	29.0	81.2	85.8	47.0	30.7	61.1	37.0	26.3
05/25/93	00:00	1231.3	71.1	77.2	40.1	79.6	87.0	43.2	29.2	81.2	85.6	47.3	31.0	61.1	37.3	26.2
05/25/93	04:00	1235.3	70.7	77.2	40.3	78.8	86.8	43.4	29.4	81.1	85.1	47.4	31.2	61.2	37.4	26.5
05/25/93	08:00	1239.3	70.3	76.8	40.2	78.3	86.6	43.5	29.4	80.9	84.5	47.5	31.1	61.1	37.4	26.5
05/25/93	12:00	1243.3	69.6	76.3	39.9	77.7	86.0	43.2	29.2	81.5	83.8	47.3	31.0	60.6	37.3	26.4
05/25/93	16:00	1247.3	69.3	75.9	40.0	77.2	85.6	43.2	29.4	81.9	83.1	47.1	31.2	60.7	37.2	26.4
05/25/93	20:00	1251.3	69.1	75.9	40.4	77.1	84.9	43.4	29.4	82.2	82.6	47.4	31.2	60.8	37.2	26.5
05/26/93	00:00	1255.3	68.9	75.8	40.7	77.0	85.2	43.7	29.7	82.3	82.4	47.6	31.4	60.9	37.4	26.6
05/26/93	04:00	1259.3	68.0	75.9	40.7	78.7	84.9	43.8	29.7	82.2	82.7	47.6	31.5	60.9	37.5	26.6
05/26/93	08:00	1263.3	67.9	75.4	40.7	76.3	84.8	43.9	29.8	83.0	82.1	47.7	31.7	60.9	37.7	26.7
05/26/93	12:00	1267.3	67.6	74.7	40.5	75.3	84.4	43.7	29.6	83.4	81.4	47.6	31.4	60.5	37.6	26.7
05/26/93	16:00	[illegible]	67.2	74.3	40.4	75.4	83.7	43.8	29.7	83.7	80.6	47.4	31.5	60.3	37.4	[illegible]

Date	Time	C6D	C1B	C1C	C2A	C2B	C2C	C2D	C3A	C3B	C3C	C3D	C4A	C4B	C4C	C4D	C6B
Maximum Temp.--		30.5	88.4	42.6	82.0	84.7	48.7	31.9	96.3	98.5	52.0	32.7	92.1	96.3	49.4	31.9	90.1
05/21/93	12:00	28.2	67.3	35.3	71.3	78.8	41.5	27.8	90.2	90.4	46.3	28.9	79.8	85.6	47.4	28.9	78.0
05/21/93	16:00	28.4	67.1	35.6	71.4	78.6	41.4	27.8	89.9	90.3	46.2	29.0	79.6	85.9	47.6	29.0	78.8
05/21/93	20:00	28.6	67.3	35.9	71.6	79.0	41.7	28.0	89.6	90.5	46.3	29.0	79.8	86.8	47.4	29.1	79.5
05/22/93	00:00	28.7	67.4	36.2	70.9	79.1	42.0	28.1	89.4	90.3	46.7	29.2	79.9	86.9	47.9	29.4	79.1
05/22/93	04:00	28.7	67.4	36.2	70.5	79.2	42.1	28.2	89.0	89.9	47.0	29.2	79.6	86.6	48.1	29.5	79.0
05/22/93	08:00	28.8	67.4	36.4	71.2	79.2	42.2	28.3	89.6	90.5	47.0	29.3	79.4	86.4	48.2	29.5	81.2
05/22/93	12:00	28.6	66.9	35.9	70.5	79.0	42.1	28.2	89.7	90.4	46.9	29.3	78.5	86.3	48.0	29.3	81.9
05/22/93	16:00	28.7	66.9	36.1	70.8	79.3	42.1	28.2	89.9	90.6	46.8	29.3	78.5	86.2	47.9	29.4	80.8
05/22/93	20:00	28.9	67.3	36.5	65.4	79.6	42.8	28.4	91.8	92.0	47.4	29.5	82.7	87.8	48.4	29.7	75.4
05/23/93	00:00	28.9	67.4	36.6	69.0	79.7	42.9	28.5	90.6	91.1	47.5	29.5	82.0	87.3	48.5	29.8	76.0
05/23/93	04:00	28.9	67.5	36.8	68.5	80.1	43.2	28.5	90.9	91.6	47.7	29.5	82.2	88.3	48.6	29.8	75.7
05/23/93	08:00	29.1	67.7	37.1	70.4	80.0	43.2	28.6	91.1	91.7	47.9	29.7	81.9	87.7	48.7	29.8	75.2
05/23/93	12:00	29.1	67.8	37.3	70.4	78.7	43.3	28.6	90.9	91.7	48.0	29.7	82.0	87.1	48.8	29.9	74.7
05/23/93	16:00	29.2	67.8	37.5	70.2	79.6	43.5	28.7	90.9	91.7	48.4	29.8	81.9	87.0	49.0	30.0	75.0
05/23/93	20:00	28.8	67.6	37.3	69.9	79.3	43.2	28.4	90.4	91.3	48.1	29.5	81.3	86.5	48.6	29.8	73.0
05/24/93	00:00	29.2	68.0	37.7	70.0	78.7	43.6	28.8	90.4	91.4	48.7	29.9	81.4	86.8	48.9	30.0	75.1
05/24/93	04:00	29.3	68.2	38.0	70.3	80.3	44.0	28.9	89.8	90.8	48.9	29.9	81.5	86.9	49.0	30.1	74.0
05/24/93	08:00	29.3	68.1	38.0	70.2	80.3	44.6	28.9	88.6	89.0	49.1	30.0	81.0	87.8	49.1	30.1	72.2
05/24/93	12:00	28.9	67.7	37.7	69.4	79.9	45.8	28.6	88.9	89.1	48.9	29.8	80.6	86.6	48.8	29.8	70.2
05/24/93	16:00	29.0	67.5	37.5	69.8	79.6	47.0	28.7	88.7	89.2	48.9	29.8	80.5	85.7	48.6	29.9	69.6
05/24/93	20:00	29.1	67.9	38.1	70.6	79.9	47.8	28.8	88.9	89.6	49.1	29.8	81.0	86.1	48.7	29.9	71.1
05/25/93	00:00	29.3	68.1	38.4	70.8	79.8	47.9	29.0	89.1	89.8	49.5	30.1	81.4	84.5	49.0	30.1	71.0
05/25/93	04:00	29.4	68.2	38.6	70.2	79.6	48.4	29.2	88.8	89.7	49.8	30.3	81.2	84.8	49.1	30.3	68.3
05/25/93	08:00	29.2	68.1	38.6	69.2	79.3	48.0	29.3	88.5	89.4	50.0	30.4	80.8	84.5	49.1	30.3	70.6
05/25/93	12:00	29.2	67.7	38.2	68.5	78.7	48.0	29.1	87.8	88.4	50.0	30.1	80.6	82.8	49.0	30.1	69.2
05/25/93	16:00	29.4	67.4	38.3	68.2	78.5	48.1	29.2	87.2	88.0	49.9	30.3	80.0	84.3	48.9	30.3	69.0
05/25/93	20:00	29.4	67.6	38.8	68.1	78.7	48.3	29.2	87.1	88.1	50.2	30.3	80.2	84.4	48.9	30.3	71.6
05/26/93	00:00	29.6	67.8	39.1	67.7	78.8	48.1	29.4	87.0	88.1	50.4	30.5	80.2	84.5	49.1	30.5	72.1
05/26/93	04:00	29.6	67.6	39.2	66.3	78.7	48.0	29.5	87.1	88.2	50.6	30.6	81.5	84.6	49.3	30.5	71.9
05/26/93	08:00	29.8	67.6	39.3	66.4	78.5	48.2	29.6	87.0	88.1	50.9	30.7	80.6	84.4	49.3	30.7	72.4
05/26/93	12:00	29.5	67.2	39.1	65.7	77.8	48.2	29.4	86.2	87.3	50.8	30.6	80.2	83.9	49.2	30.5	74.2
05/26/93	16:00	29.6	66.8	39.0	65.3	77.6	48.1	29.5	85.7	86.9	50.7	30.6	79.9	83.2	49.0	30.5	72.2

Table B-4 Ground Electrode and Outside Thermowell Temperatures (Recorded by Data Logger) [Continued]

Date	Time	Elapsed Time	A2A	A2B	A2C	A3A	A3B	A3C	A3D	A4A	A4B	A4C	A4D	TW7B	TW7C	TW7D	C6D	C1B	C1C	C2A	C2B	C2C	C2D	C3A	C3B	C3C	C3D	C4A	C4B	C4C	C4D	C6B
Maximum Temp.--			70.5	84.2	42.3	86.3	95.5	45.4	32.0	112.2	86.6	48.7	33.9	62.0	38.7	27.7	30.5	68.4	42.6	82.0	84.7	48.7	31.9	86.3	98.5	52.0	32.7	92.1	96.3	49.4	31.9	90.1
05/26/93	20:00	1275.3	66.9	74.4	40.8	74.5	83.8	43.8	29.8	83.6	80.0	47.5	31.5	60.4	37.3	26.7	29.8	67.0	39.6	65.2	78.0	48.3	29.6	85.6	87.0	50.7	30.6	79.3	83.4	48.9	30.4	69.0
05/27/93	00.00	1279.3	66.5	74.3	41.0	74.2	83.2	44.0	30.0	83.8	79.8	47.8	31.7	60.5	37.6	26.7	29.7	67.1	39.8	64.7	78.0	48.5	29.8	85.4	86.9	51.2	30.9	78.9	83.2	49.2	30.7	70.6
05/27/93	04:00	1283.3	66.2	74.1	41.0	73.9	83.7	44.2	30.1	84.1	79.4	47.6	31.8	60.5	37.7	26.8	29.8	67.0	39.9	64.1	77.9	48.6	29.9	85.2	86.7	51.3	31.0	78.6	83.0	49.3	30.8	68.6
05/27/93	08.00	1287.3	65.7	73.9	41.1	73.7	83.0	44.2	30.1	84.6	79.1	47.9	31.9	60.4	37.8	26.8	29.7	66.9	40.0	63.4	77.7	48.7	30.0	84.9	86.4	51.5	31.0	78.3	81.8	49.4	30.8	68.7
05/27/93	12:00	1291.3	64.8	73.2	40.5	72.9	82.7	43.6	29.7	84.9	78.0	47.4	31.5	59.8	37.3	26.4	29.4	66.1	39.5	62.2	77.0	48.1	29.7	84.1	85.5	51.0	30.8	77.6	80.3	48.7	30.4	69.0
05/27/93	16.00	1295.3	64.6	72.8	40.5	71.9	82.6	43.7	29.8	85.1	77.6	47.4	31.7	59.6	37.4	26.3	29.3	65.9	39.5	61.8	76.7	48.0	29.6	83.5	85.0	50.9	30.7	76.8	82.3	48.6	30.3	64.6
05/27/93	20.00	1299.3	64.3	73.2	41.0	72.3	82.5	44.0	30.0	85.8	77.7	47.5	31.8	59.9	37.3	26.6	29.6	66.3	40.2	61.6	77.3	48.3	29.9	83.4	85.3	51.1	30.8	76.7	79.3	48.7	30.5	64.5
05/28/93	00.00	1303.3	64.2	73.3	41.3	72.3	82.8	44.4	30.2	87.0	78.2	48.0	32.1	60.2	37.8	26.8	29.8	66.4	40.4	61.6	77.4	48.6	30.2	83.6	85.4	51.6	31.2	77.2	81.6	49.2	30.9	66.5
05/28/93	04:00	1307.3	64.2	73.0	41.3	72.6	82.6	44.4	30.2	87.9	78.2	47.9	32.1	60.0	37.8	26.9	29.8	66.2	40.5	61.1	77.1	48.5	30.1	83.4	85.2	51.6	31.1	77.2	82.2	49.2	30.8	69.7
05/28/93	08:00	1311.3	63.9	72.9	41.4	72.9	82.5	44.5	30.3	89.1	78.1	48.0	32.2	60.0	37.9	26.9	29.9	66.2	40.6	61.1	76.9	48.3	30.2	83.6	85.2	51.7	31.2	77.5	81.4	49.1	30.9	70.3
05/28/93	12:00	1315.3	63.7	72.4	41.0	72.2	82.3	44.4	30.2	89.9	77.0	48.0	32.0	59.6	37.9	27.0	29.7	65.9	40.3	60.9	75.2	48.3	30.2	83.3	84.6	51.7	31.2	77.2	82.4	49.1	30.8	72.2
05/28/93	16.00	1319.3	63.3	72.2	41.2	71.9	81.9	44.0	30.2	90.8	76.0	47.5	32.0	59.4	37.1	26.4	29.7	65.5	40.4	61.2	76.3	47.8	30.0	82.7	84.5	51.0	30.9	76.9	82.9	48.4	30.5	74.4
05/28/93	20:00	1323.3	62.8	72.5	41.6	71.8	82.2	44.6	30.5	91.8	76.1	48.0	32.3	59.8	37.8	26.8	30.1	65.8	40.9	61.5	76.7	48.4	30.3	82.6	84.7	51.6	31.3	77.1	83.1	49.1	31.0	73.5
05/29/93	00.00	1327.3	62.6	72.4	41.6	71.7	81.4	44.7	30.6	92.5	76.7	48.2	32.5	59.9	38.0	27.0	30.1	65.8	41.2	60.9	76.1	48.5	30.5	82.1	84.3	51.8	31.5	77.2	83.3	49.3	31.1	72.8
05/29/93	04:00	1331.3	62.6	72.3	41.6	71.6	82.1	44.7	30.5	93.4	76.8	48.2	32.4	59.7	37.9	27.0	30.1	65.7	41.2	60.7	76.3	48.3	30.5	82.1	84.0	51.8	31.5	77.2	83.4	49.3	31.1	74.9
05/29/93	08:00	1335.3	62.6	72.1	41.6	71.6	82.0	44.8	30.5	94.4	76.9	48.3	32.4	59.7	38.1	27.1	30.3	65.6	41.3	60.9	76.4	48.3	30.5	82.0	83.8	51.8	31.6	77.3	83.1	49.3	31.1	77.0
05/29/93	12:00	1339.3	62.4	71.8	41.3	70.9	81.8	44.7	30.6	94.6	76.7	48.2	32.4	59.3	38.0	27.0	30.1	65.4	41.1	60.7	75.5	48.3	30.5	81.6	83.2	51.8	31.7	77.1	82.8	49.1	31.1	77.8
05/29/93	16.00	1343.3	62.3	71.3	41.2	70.7	81.4	44.4	30.4	95.6	76.0	47.9	32.3	59.0	37.8	26.7	29.9	64.9	41.1	60.8	75.5	47.6	30.3	81.1	82.9	51.2	31.3	77.4	82.6	48.8	30.8	75.2
05/29/93	20:00	1347.3	62.3	71.6	41.8	71.2	81.5	44.6	30.7	96.8	76.1	48.0	32.4	59.3	37.5	26.7	30.3	65.2	41.7	61.2	76.0	48.0	30.5	81.2	83.3	51.4	31.4	77.5	83.1	48.7	30.9	73.7
05/30/93	00 00	1351.3	62.2	71.9	41.9	71.2	81.7	45.0	30.9	97.3	76.3	48.3	32.8	59.6	38.0	27.2	30.2	65.4	41.9	61.1	76.1	48.3	30.7	81.4	83.3	51.8	31.7	77.4	83.5	49.2	31.2	73.2
05/30/93	04 00	1355.3	62.2	71.6	41.9	71.1	81.6	45.0	30.9	98.0	76.4	48.4	32.8	59.5	38.2	27.2	30.3	65.2	41.9	61.6	75.9	48.3	30.7	81.4	83.2	51.6	31.7	77.1	83.2	49.3	31.3	74.3
05/30/93	08.00	1359.3	62.1	71.7	42.1	71.4	81.7	45.2	31.1	98.8	76.1	48.6	32.9	59.6	38.3	27.4	30.5	65.4	42.1	61.5	75.9	48.6	31.0	81.7	83.5	52.0	32.0	77.5	83.5	49.4	31.5	72.9
05/30/93	12 00	1363.3	61.9	71.3	41.7	70.6	81.5	45.1	31.0	99.0	75.9	48.5	32.7	59.2	38.4	27.4	30.1	65.0	41.6	60.4	75.2	48.5	30.8	81.1	82.8	51.9	31.9	76.2	82.4	49.3	31.4	72.5
05/30/93	16 00	1367.3	61.5	70.8	41.3	70.1	81.0	44.7	30.8	99.5	75.1	48.1	32.8	58.6	38.0	27.0	29.9	64.4	41.6	59.9	74.9	48.0	30.6	80.6	82.2	51.3	31.7	76.2	82.7	48.8	31.1	70.5
05/30/93	20 00	1371.3	61.7	70.9	41.9	70.4	81.0	44.7	31.0	100.4	75.0	47.9	32.8	58.7	37.7	26.9	30.2	64.6	42.1	60.6	75.4	48.0	30.8	80.4	82.5	51.1	31.7	75.8	82.7	48.6	31.2	68.1
05/31/93	00 00	1375.3	61.8	71.2	42.1	70.6	81.2	45.1	31.2	101.4	75.8	48.4	33.0	59.0	38.2	27.2	30.3	64.9	42.4	61.0	75.4	48.4	31.0	80.7	82.7	51.5	31.9	76.6	83.5	49.1	31.4	73.0
05/31/93	04.00	1379.3	62.1	71.1	42.1	70.7	81.2	45.2	31.2	102.2	76.0	48.4	33.1	59.1	38.5	27.3	30.4	64.8	42.4	61.3	75.4	48.4	31.1	80.8	82.8	51.6	32.0	76.3	83.3	49.2	31.6	72.7
05/31/93	08 00	1383.3	62.4	71.2	42.2	70.8	81.3	45.3	31.4	103.1	76.3	48.7	33.1	59.0	38.5	27.4	30.2	64.9	42.6	61.8	75.3	48.7	31.3	80.9	82.7	51.8	32.2	76.2	80.6	49.3	31.5	73.4
05/31/93	12.00	1387.3	62.0	70.4	41.6	70.4	80.7	44.8	31.2	103.4	76.4	48.2	33.0	58.5	38.3	27.2	30.2	64.2	42.0	61.5	74.5	48.2	31.0	80.3	82.2	51.4	32.1	76.1	82.9	48.8	31.3	77.0
05/31/93	16 00	1391.3	62.2	70.3	41.8	71.0	80.8	45.0	31.4	104.8	76.2	48.3	33.3	58.6	38.6	27.4	30.4	64.2	42.0	62.2	74.5	48.1	31.1	80.3	82.1	51.3	32.1	76.5	83.2	48.9	31.5	71.0
05/31/93	20 00	1395.3	62.0	70.5	42.1	71.3	80.0	45.0	31.5	105.4	75.8	48.3	33.2	58.7	38.3	27.4	30.5	64.3	42.4	62.5	74.9	48.3	31.3	80.3	82.5	51.2	32.1	75.9	83.4	48.8	31.7	69.5
06/01/93	00 00	1399.3	62.1	70.6	42.3	71.4	80.5	45.2	31.6	105.9	76.5	48.5	33.4	59.0	38.6	27.5	30.5	64.5	42.6	62.4	75.0	48.5	31.4	80.4	82.6	51.4	32.2	76.3	83.5	49.0	31.7	69.9

Table B-4 Ground Electrode and Outside Thermowell Temperatures
(Recorded by Data Logger) [Continued]

Date	Time	Elapsed Time	A2A	A2B	A2C	A3A	A3B	A3C	A3D	A4A	A4B	A4C	A4D	TW7B	TW7C	TW7D
	Maximum Temp.--		78.5	84.2	42.3	86.3	85.5	45.4	32.0	112.2	86.6	48.7	33.9	62.0	38.7	27.7
06/01/93	04:00	1403.3	62.0	70.8	42.3	71.4	80.5	45.2	31.8	108.3	76.4	48.4	33.4	58.9	38.8	27.3
06/01/93	08:00	1407.3	61.7	70.8	42.3	71.3	80.3	45.4	31.8	108.5	76.7	48.7	33.4	58.9	38.7	27.5
06/01/93	12:00	1411.3	61.4	69.8	41.8	70.5	80.2	44.9	31.4	108.7	76.9	48.2	33.2	58.3	38.4	27.3
06/01/93	16:00	1415.3	62.1	69.7	41.7	71.4	80.4	45.0	31.8	107.9	77.2	48.2	33.5	58.3	38.5	27.5
06/01/93	20:00	1419.3	62.5	69.9	42.1	71.8	80.2	44.8	31.8	108.5	76.9	47.9	33.3	58.4	38.0	27.3
06/02/93	00:00	1423.3	63.0	70.2	42.3	72.2	80.5	45.2	31.8	109.3	77.7	48.3	33.8	58.8	38.6	27.5
06/02/93	04:00	1427.3	62.8	70.2	42.3	72.3	80.4	45.1	31.8	109.8	77.8	48.4	33.7	58.7	38.6	27.5
06/02/93	08:00	1431.3	62.9	70.0	42.2	72.2	80.5	45.3	31.8	110.2	78.1	48.4	33.7	58.7	38.7	27.7
06/02/93	12:00	1435.3	62.7	69.5	41.7	72.9	80.0	44.9	31.7	110.2	77.9	48.1	33.5	58.1	38.4	27.5
06/02/93	16:00	1439.3	62.5	69.1	41.8	73.7	79.9	44.7	31.8	110.8	77.7	47.9	33.5	57.9	38.3	27.3
06/02/93	20:00	1443.3	62.6	69.6	42.2	74.4	80.0	44.8	31.8	111.3	78.4	47.9	33.7	58.3	38.0	27.4
06/03/93	00:00	1447.3	62.6	69.8	42.2	72.8	80.2	45.1	32.0	111.9	79.6	48.2	33.8	58.5	38.5	27.6
06/03/93	04:00	1451.3	62.4	69.7	42.3	73.1	80.2	45.1	32.0	112.2	80.3	48.3	33.9	58.8	38.6	27.7
06/03/93	08:00	1455.3	62.3	69.8	42.1	73.1	80.2	45.1	32.0	111.3	80.7	48.3	33.8	58.4	38.6	27.7
06/03/93	12:00	1459.3	62.4	69.2	41.7	73.0	79.8	44.8	31.9	112.1	80.3	48.1	33.8	58.0	38.5	27.5

Date	Time	Elapsed Time	C6D	C1B	C1C	C2A	C2B	C2C	C2D	C3A	C3B	C3C	C3D	C4A	C4B	C4C	C4D	C6B
	Maximum Temp.--		30.5	68.4	42.8	82.0	84.7	48.7	31.9	96.3	98.5	52.0	32.7	92.1	96.3	49.4	31.9	90.1
06/01/93	04:00	1403.3	30.5	64.4	42.8	62.1	74.9	48.4	31.4	80.2	82.4	51.4	32.3	76.2	83.1	48.9	31.7	69.3
06/01/93	08:00	1407.3	30.3	64.5	42.8	61.7	74.8	48.7	31.7	80.3	82.2	51.8	32.5	75.9	83.0	49.0	31.7	65.8
06/01/93	12:00	1411.3	30.2	63.8	41.9	61.0	73.9	48.1	31.2	79.3	81.3	51.2	32.2	75.8	80.4	48.8	31.5	65.7
06/01/93	16:00	1415.3	30.3	63.6	41.9	62.2	73.9	48.0	31.3	79.0	80.9	50.9	32.3	76.8	82.8	48.7	31.8	69.3
06/01/93	20:00	1419.3	30.3	63.8	42.2	63.0	74.3	48.0	31.3	78.9	81.3	50.8	32.2	76.8	82.3	48.2	31.4	69.4
06/02/93	00:00	1423.3	30.4	64.0	42.5	63.4	74.4	48.4	31.5	79.0	81.5	51.1	32.4	77.0	82.8	48.7	31.7	67.8
06/02/93	04:00	1427.3	30.5	63.9	42.4	63.2	74.3	48.3	31.8	78.9	81.4	51.0	32.5	77.2	82.8	48.7	31.7	69.5
06/02/93	08:00	1431.3	30.4	63.8	42.4	63.3	74.0	48.4	31.7	78.8	81.3	51.1	32.5	77.3	82.7	48.8	31.8	70.5
06/02/93	12:00	1435.3	30.1	63.4	41.9	62.8	73.4	48.2	31.8	78.2	80.4	50.8	32.5	77.0	82.0	48.4	31.8	69.9
06/02/93	16:00	1439.3	30.0	63.1	41.8	63.0	73.1	47.8	31.3	77.7	80.5	50.4	32.3	77.0	81.9	48.2	31.5	70.2
06/02/93	20:00	1443.3	30.4	63.4	42.2	63.2	73.9	47.8	31.8	77.8	81.1	50.3	32.4	77.2	82.8	48.0	31.8	73.3
06/03/93	00:00	1447.3	30.5	63.5	42.3	63.2	73.9	48.0	31.7	78.0	81.0	50.8	32.5	77.7	82.9	48.4	31.8	73.4
06/03/93	04:00	1451.3	30.5	63.5	42.3	63.0	73.9	47.9	31.8	77.8	80.9	50.8	32.8	77.3	83.0	48.5	31.9	73.3
06/03/93	08:00	1455.3	30.3	63.5	42.2	62.7	73.8	47.9	31.9	77.9	80.8	50.7	32.7	77.2	82.8	48.5	31.8	72.7
06/03/93	12:00	1459.3	30.2	63.0	41.8	62.5	72.9	47.8	31.8	77.4	80.2	50.4	32.7	76.3	81.2	48.2	31.7	72.8

Figure B-2

Excitor Electrode B1 Temperature

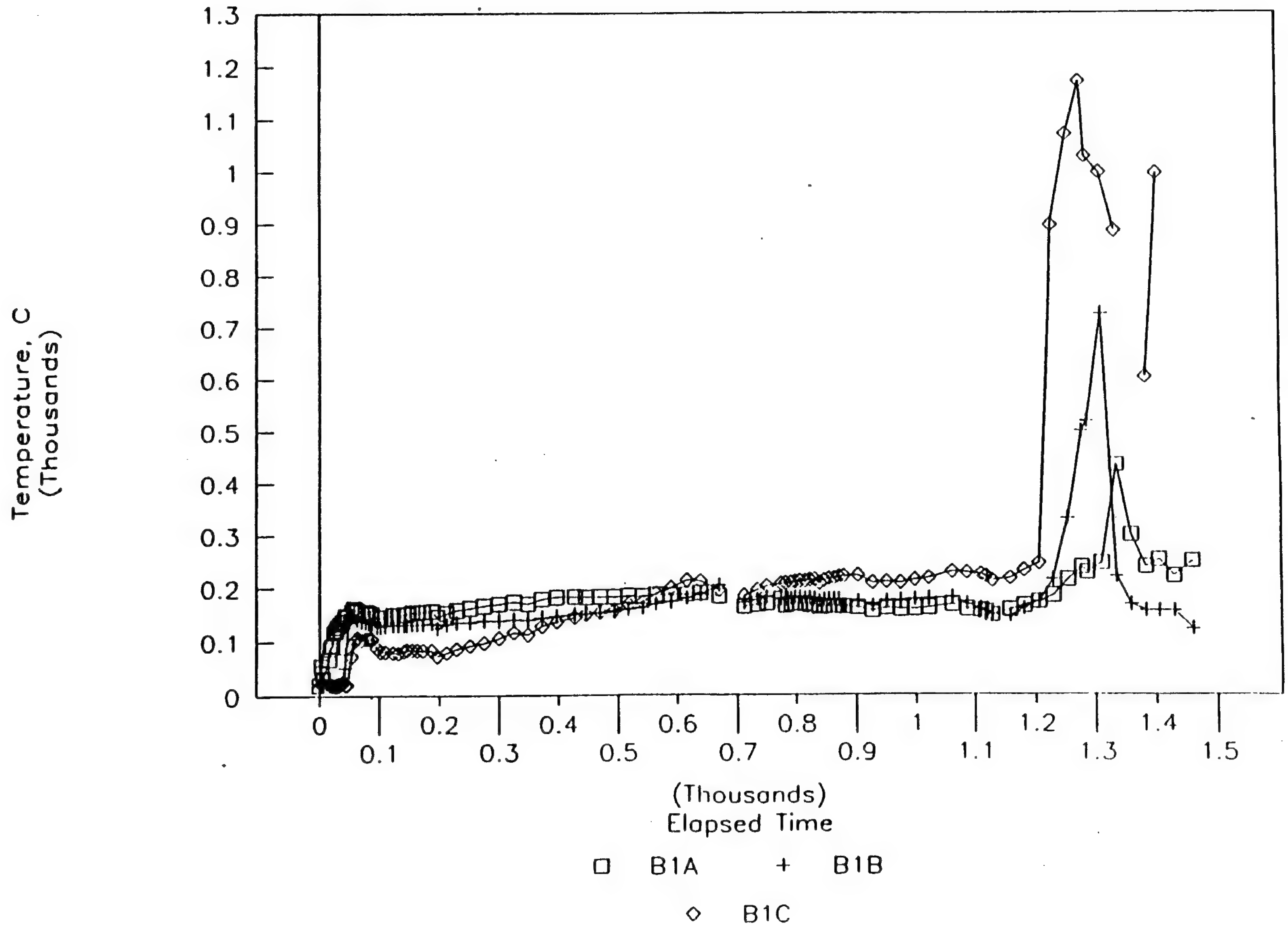


Figure B-3

Excitor Electrode B2 Temperature

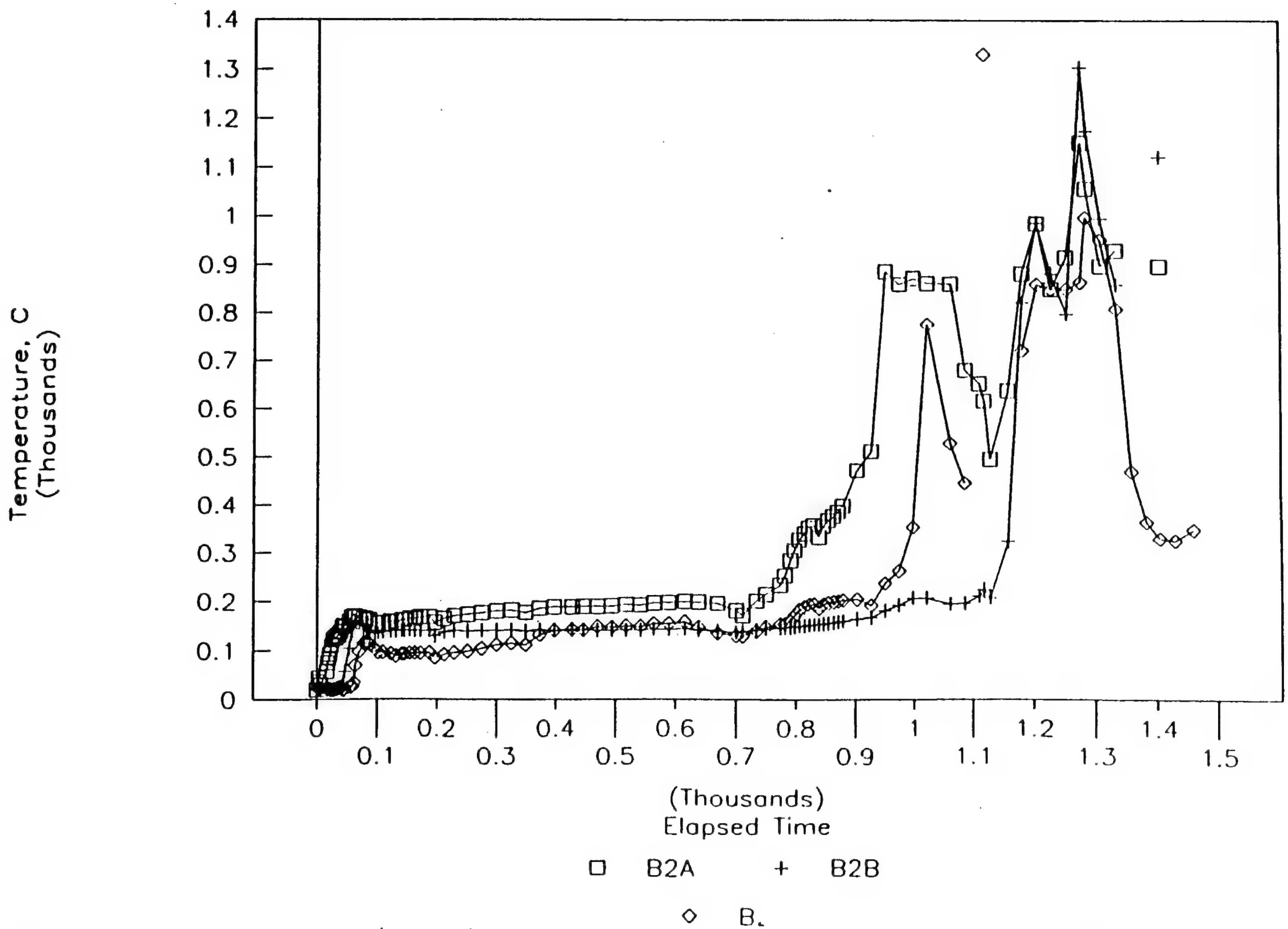


Figure B-4
Excitor Electrode B3 Temperature

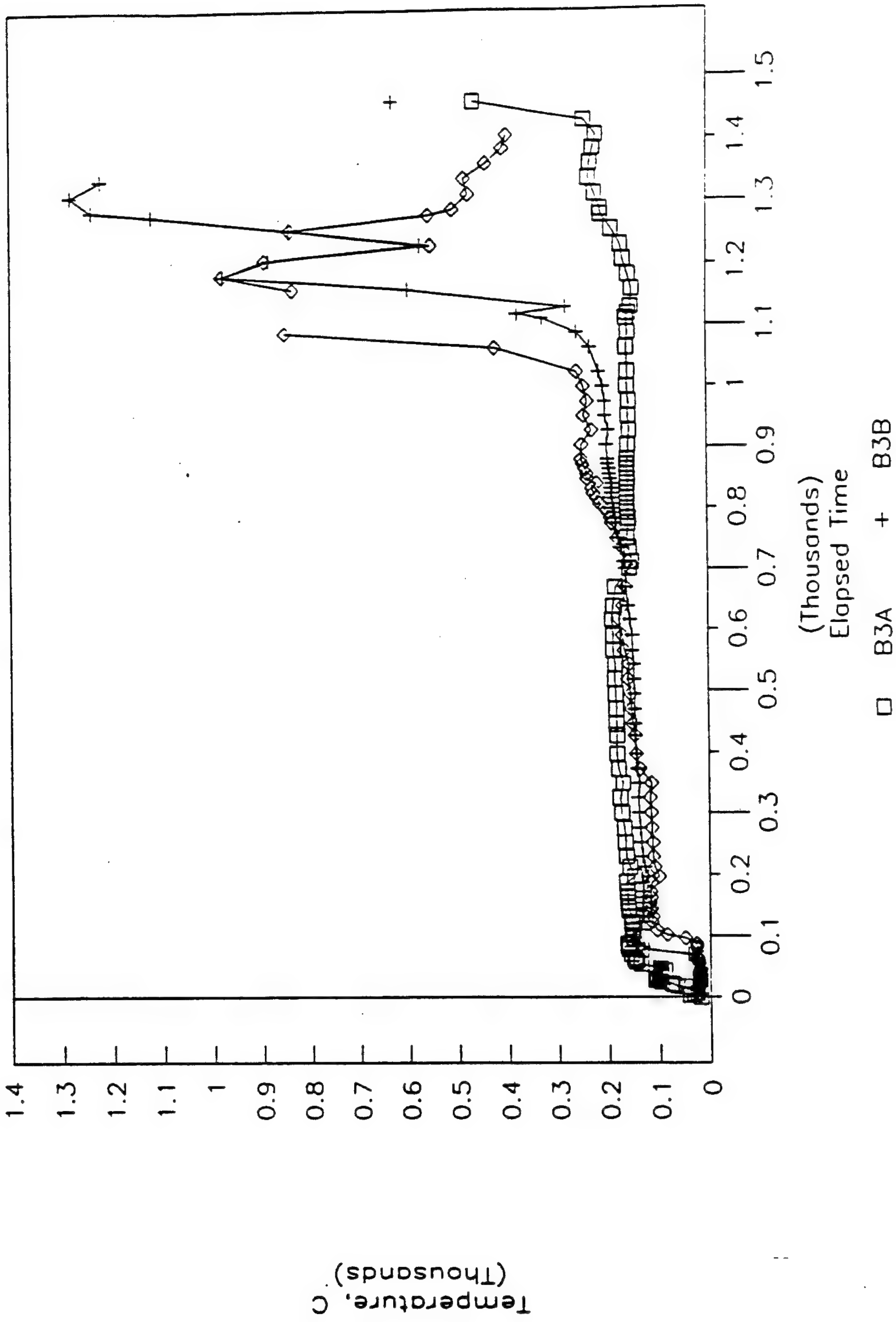
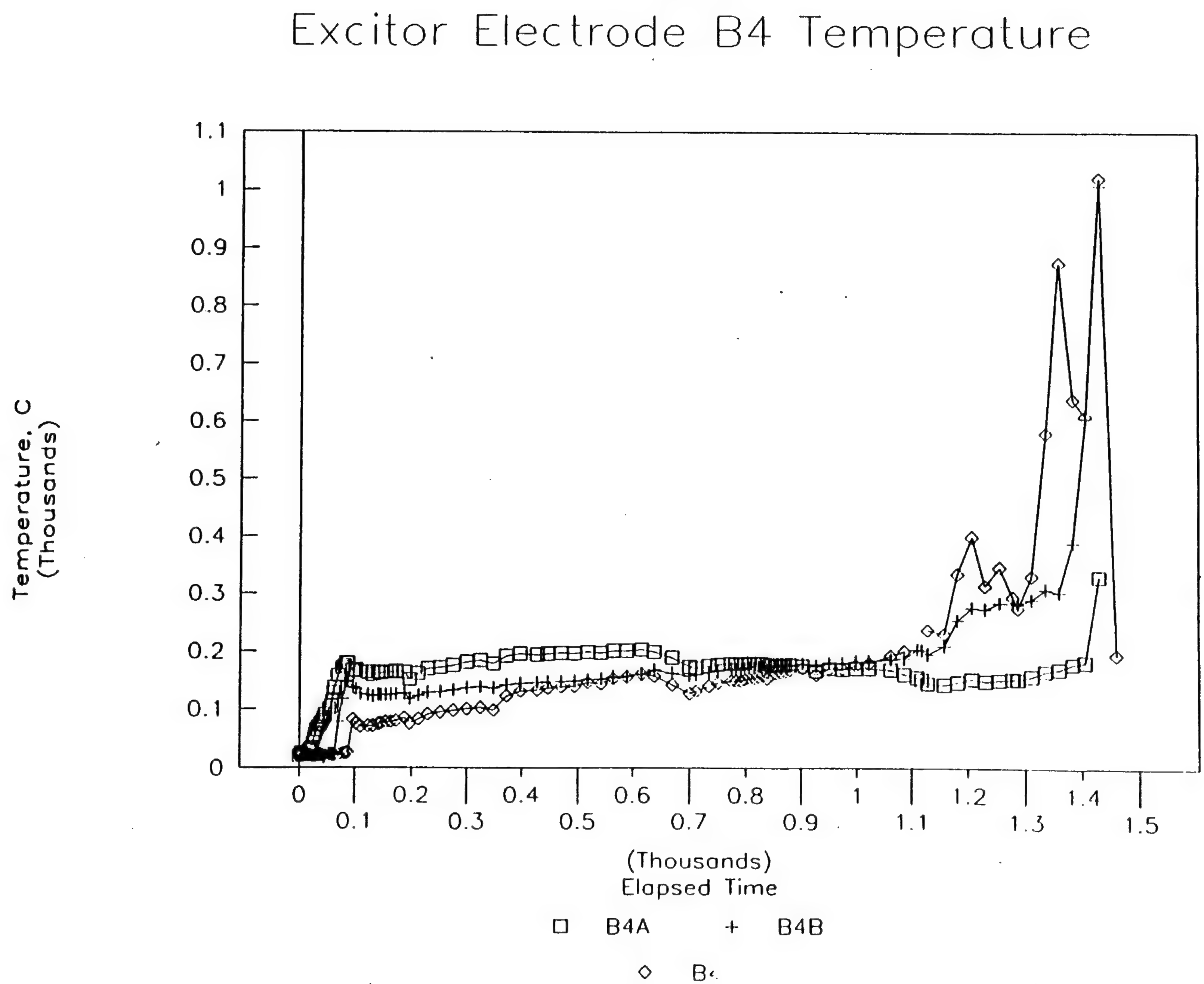


Figure B-5



Excitor Electrode B4 Temperature
Temperature, C
(Thousands)
1.1
1
0.9
0.8
0.7
0.6
0.5
0.4
0.3
0.2
0.1
0
0
0.1
0.2
0.3
0.4
0.5
0.6
0.7
0.8
0.9
1
1.1
1.2
1.3
1.4
1.5
(Thousands)
Elapsed Time
B4A
B4B

Figure B-6

GROUND ROW A (EAST ROW) TEMPERATURES

(1-ft Depth)

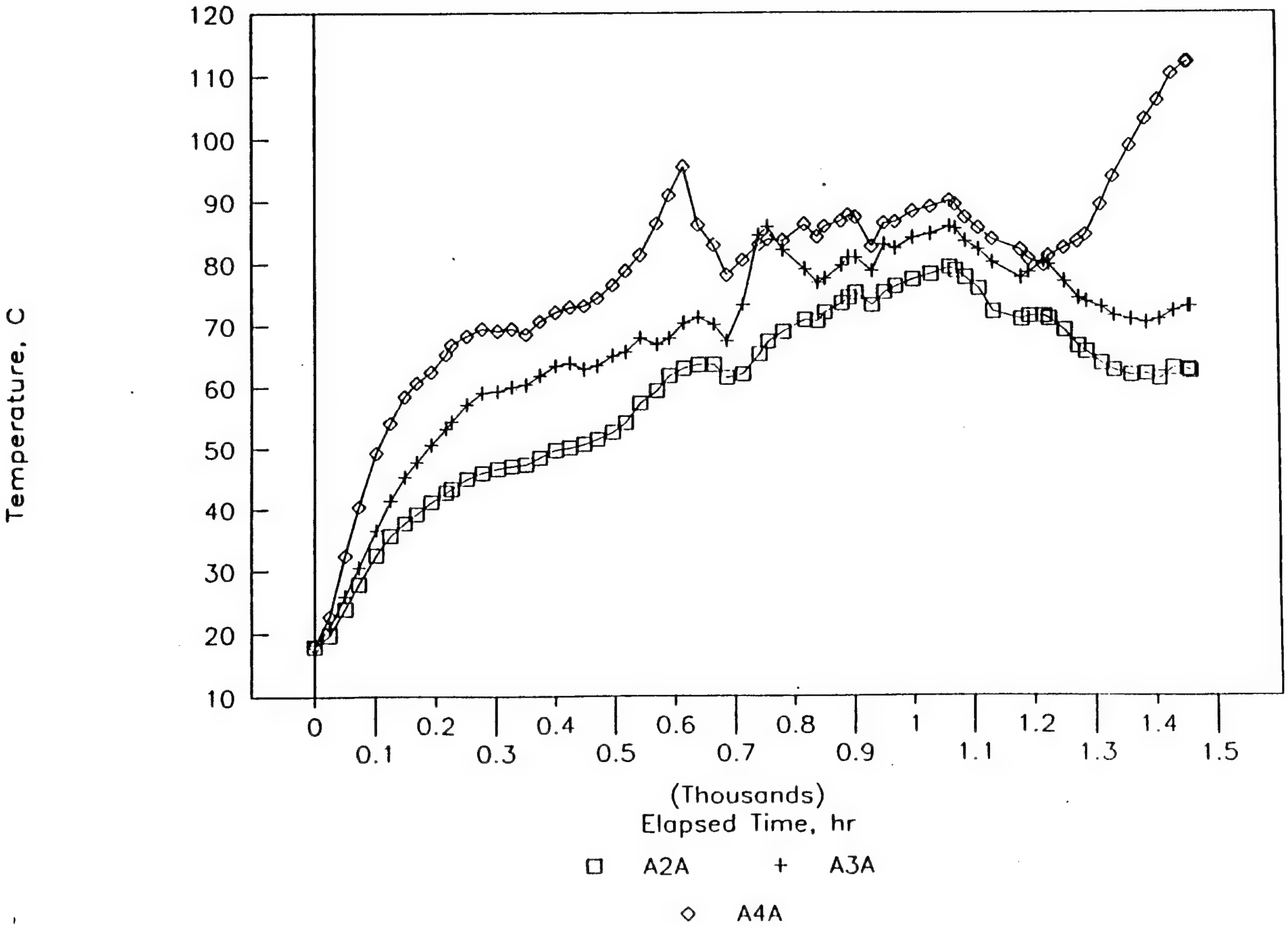


Figure B-7

GROUND ROW A (EAST ROW) TEMPERATURES

(12-ft Depth)

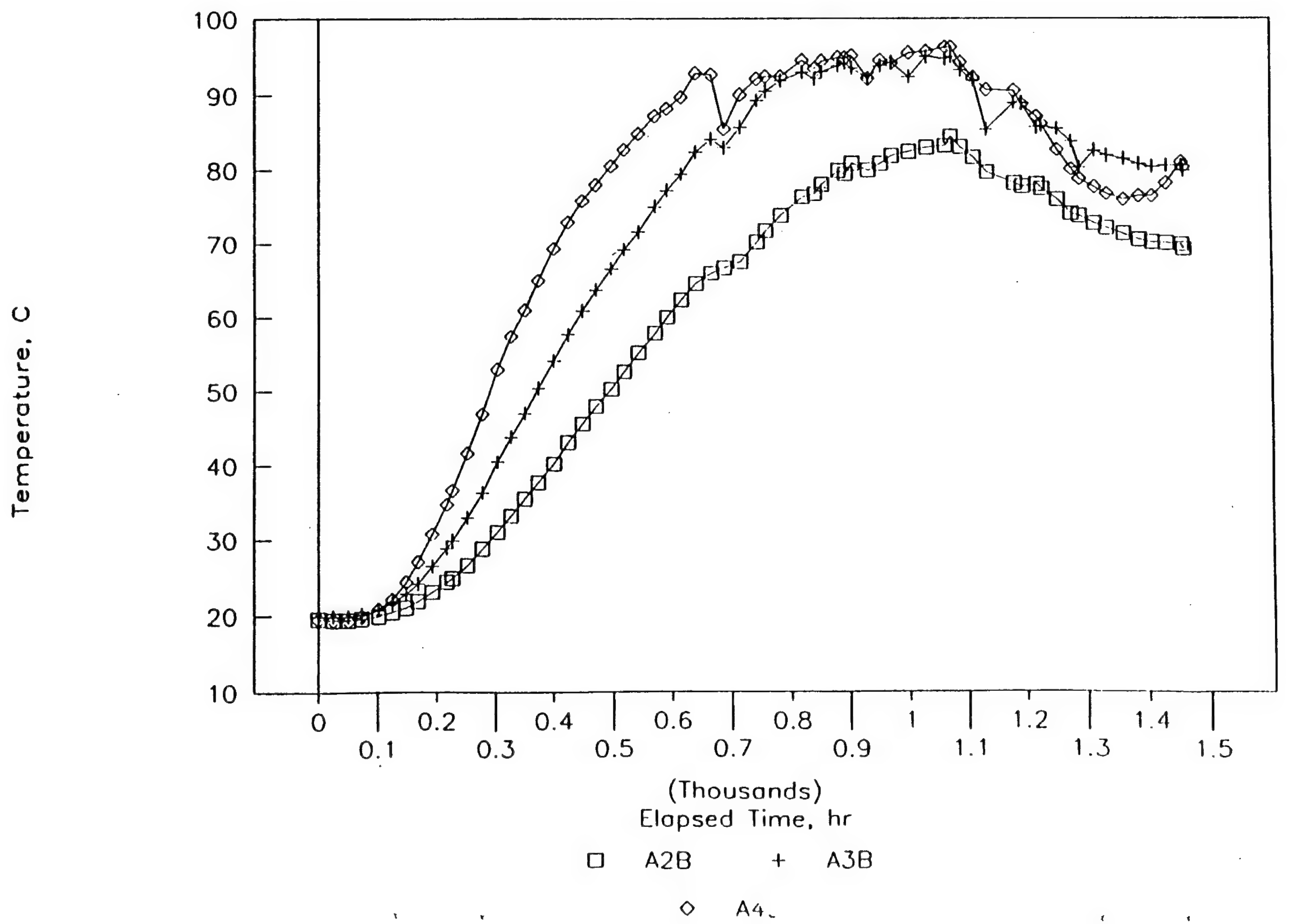


Figure B-8

GROUND ROW A (EAST ROW) TEMPERATURES

(24-ft Depth)

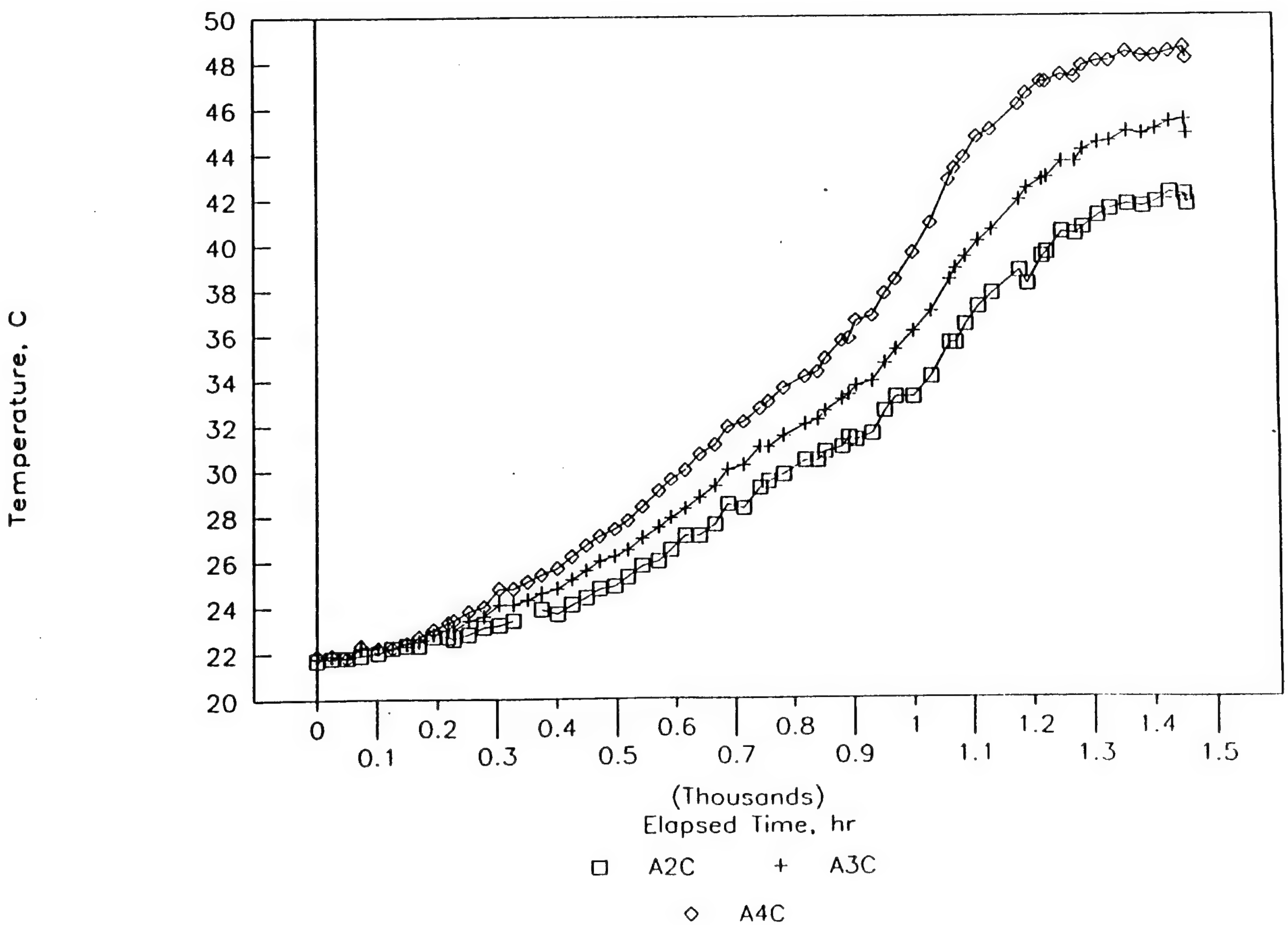


Figure B-9

GROUND ROW A (EAST ROW) TEMPERATURES

(29-ft Depth)

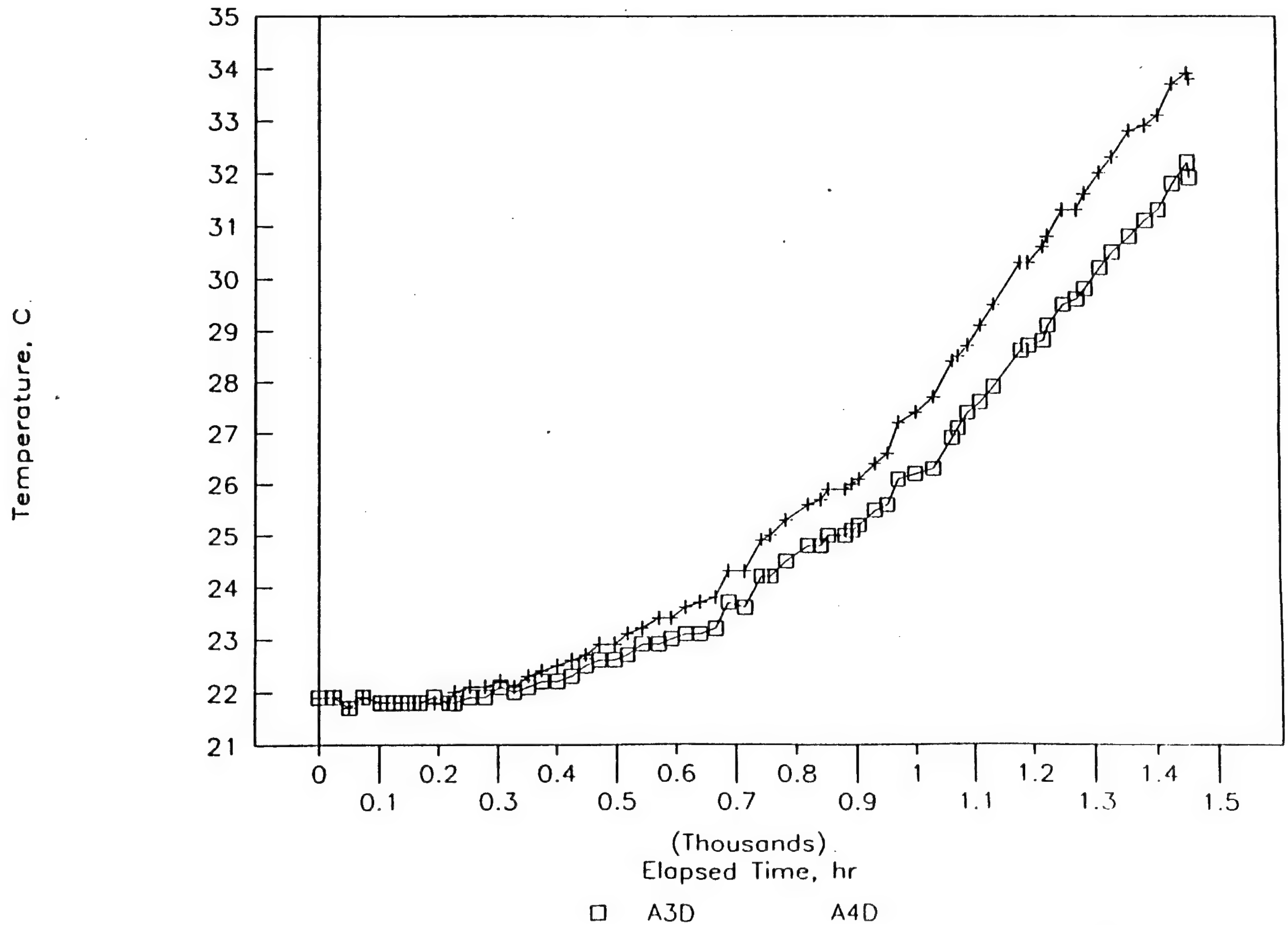


Figure B-10

GROUND ROW C (WEST ROW) TEMPERATURES

(1-ft Depth)

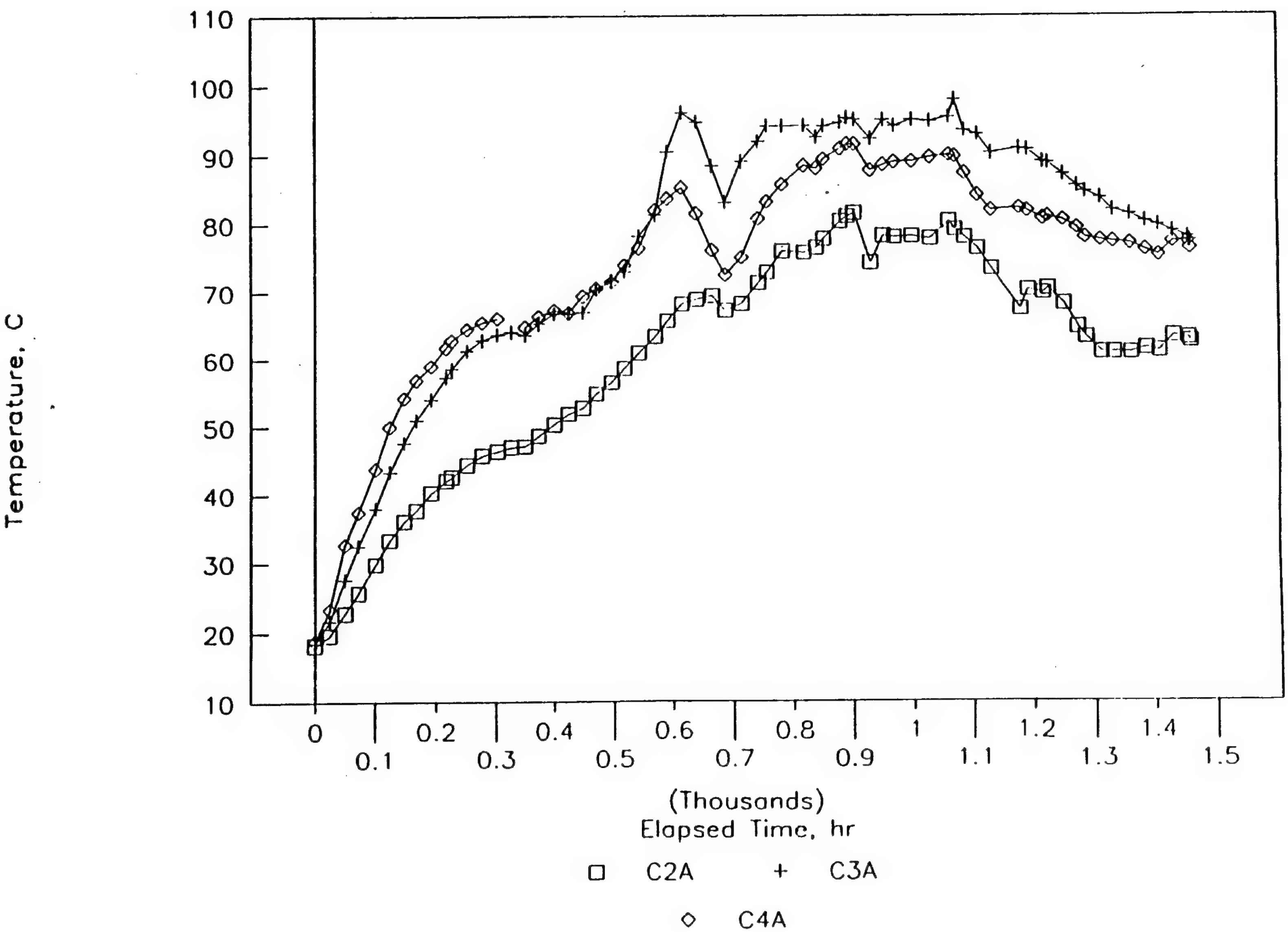


Figure B-11

GROUND ROW C (WEST ROW) TEMPERATURES

(12-ft Depth)

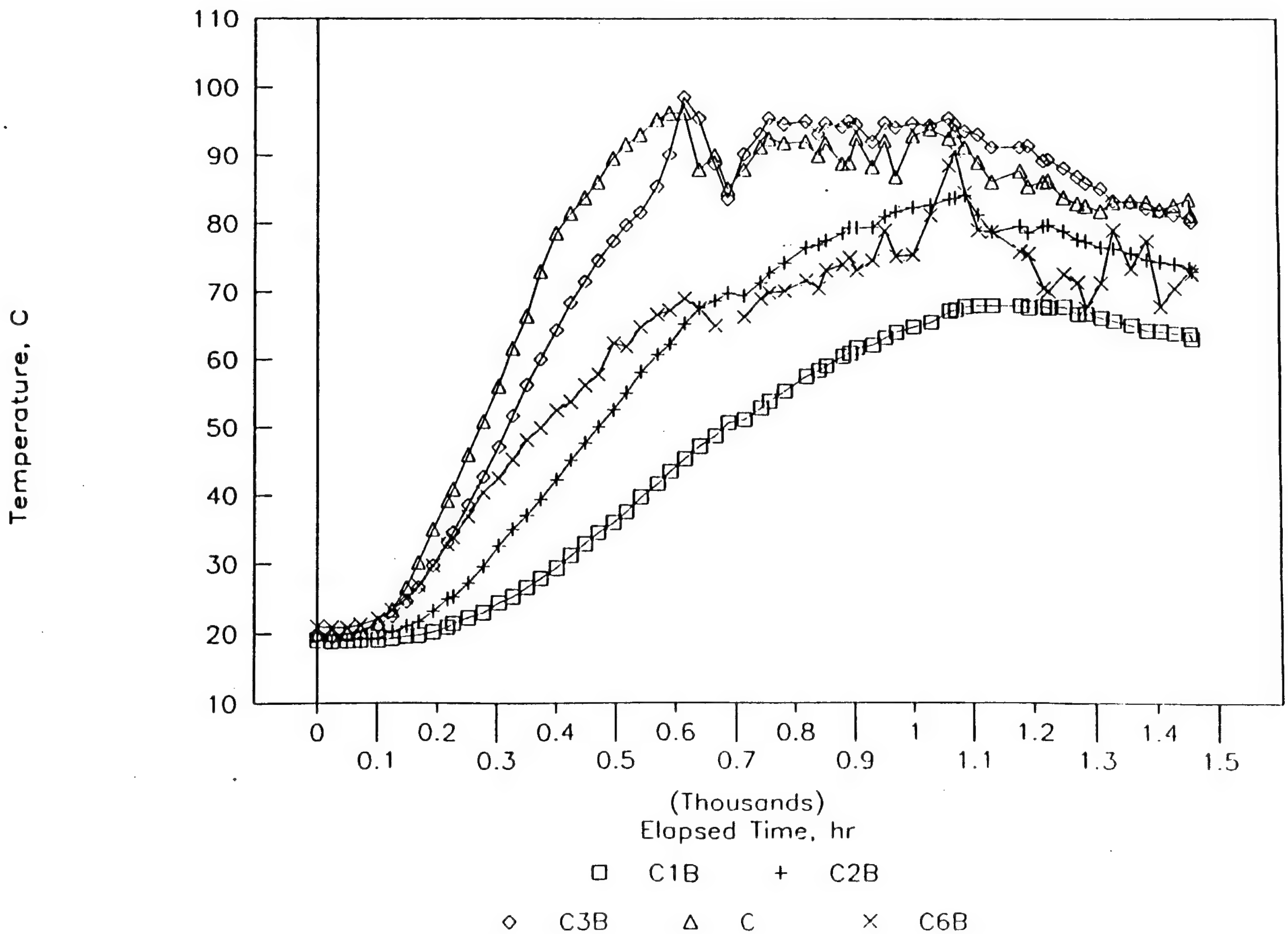


Figure B-12

GROUND ROW C (WEST ROW) TEMPERATURES

(24-ft Depth)

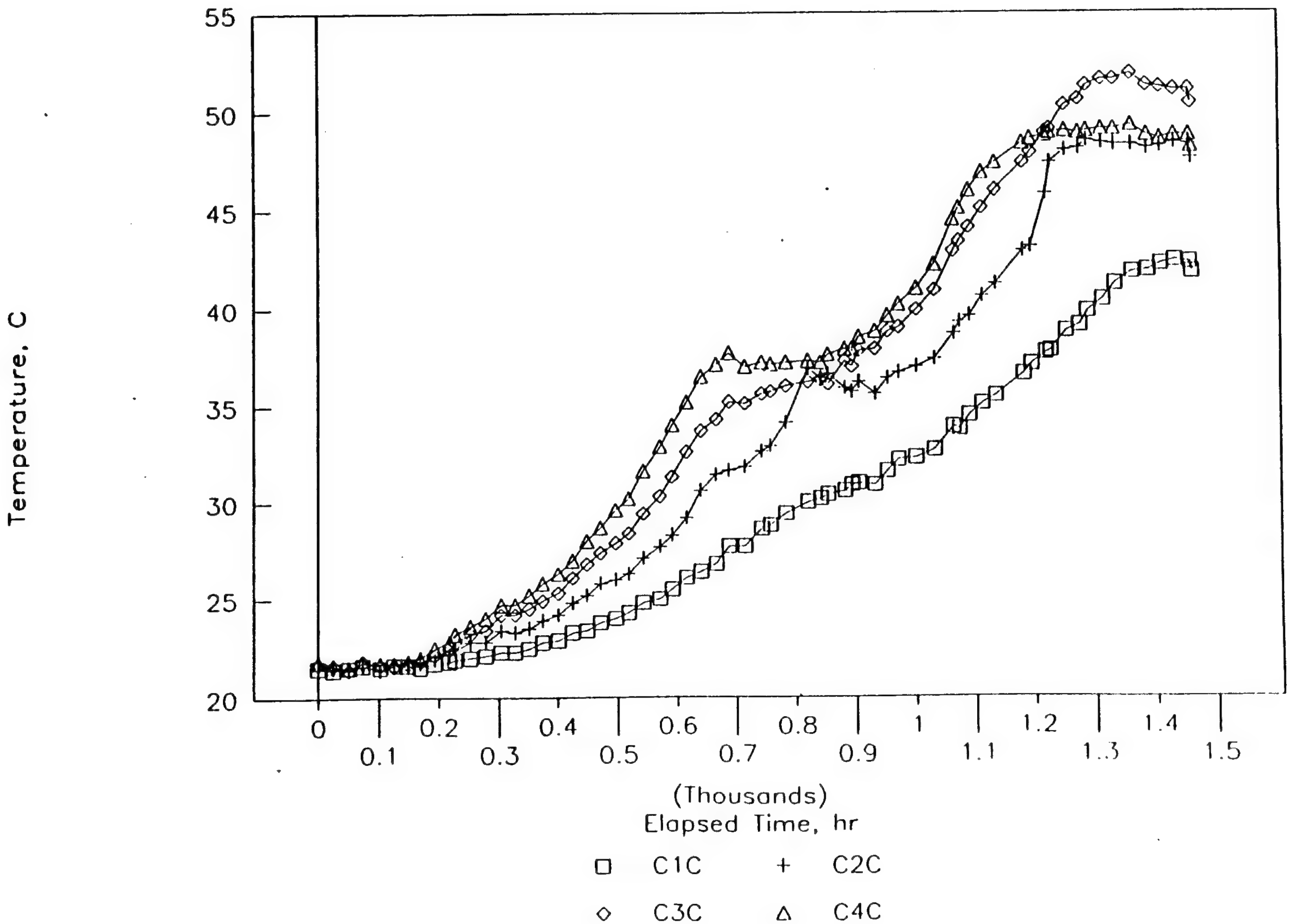


Figure B-13

GROUND ROW C (WEST ROW) TEMPERATURES

(29-ft Depth)

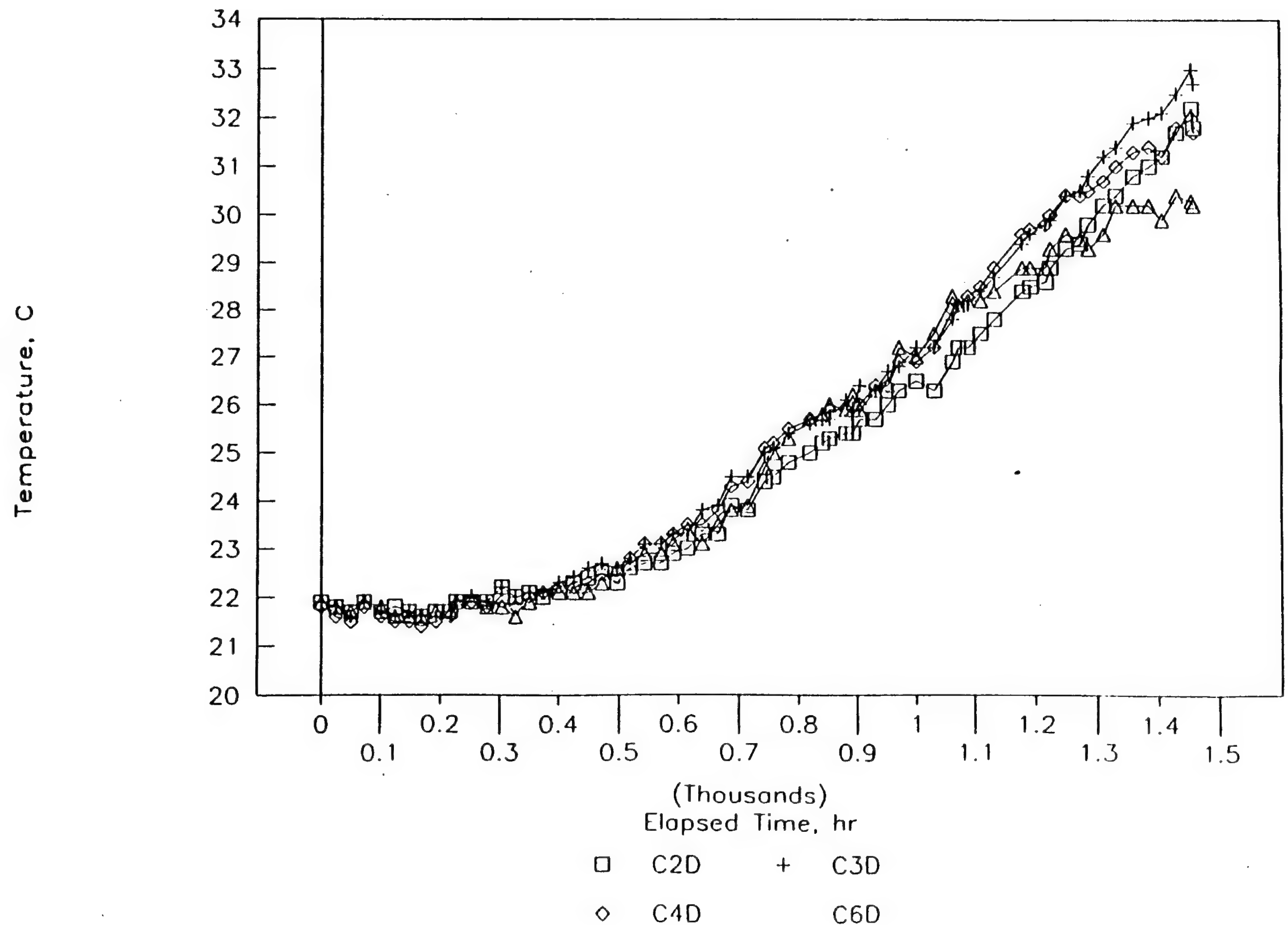
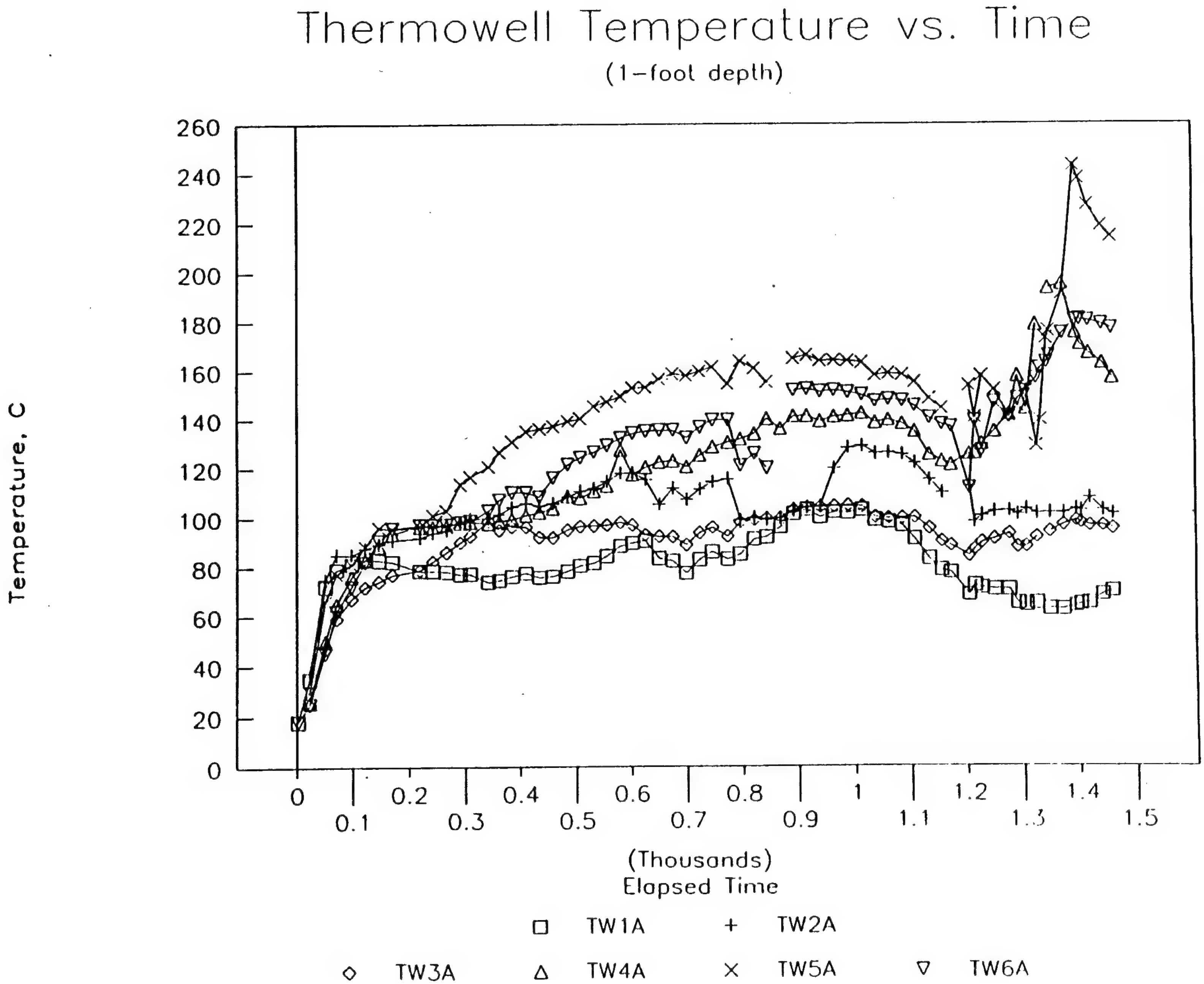


Figure B-14



Thermowell Temperature vs. Time
(1-foot depth)
Temperature, C
0
20
40
60
80
100
120
140
160
180
200
220
240
260
0
0.1
0.2
0.3
0.4
0.5
0.6
0.7
0.8
0.9
1
1.1
1.2
1.3
1.4
1.5
(Thousands)
Elapsed Time
TW1A
TW2A
TW3A
TW4A
TW5A
TW6A

Figure B-15

Thermowell Temperature vs. Time

(12-foot depth)

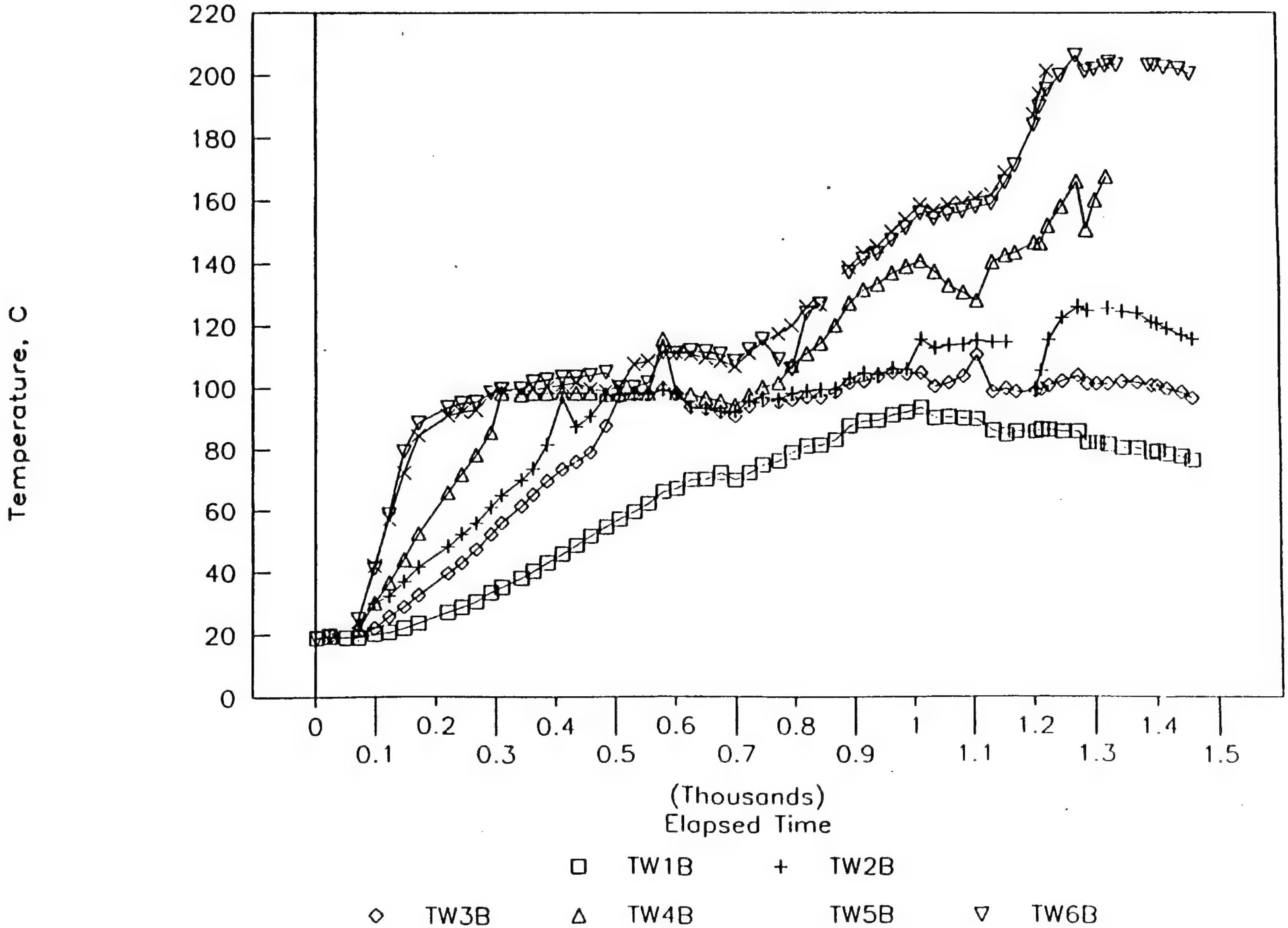
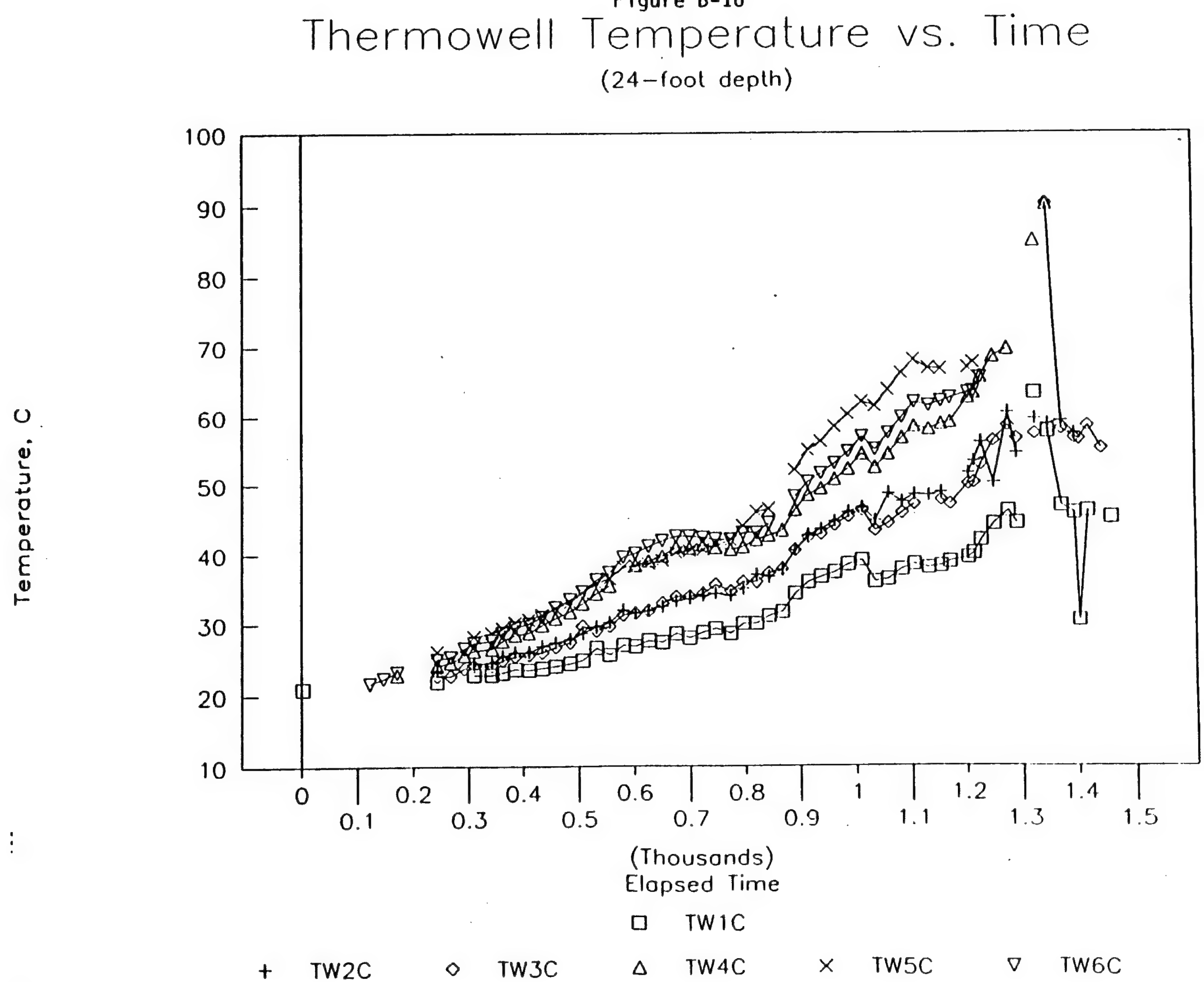


Figure B-16



Thermowell Temperature vs. Time
(24-foot depth)
Temperature, C
100
90
80
70
60
50
40
30
20
10
0
0.1
0.2
0.3
0.4
0.5
0.6
0.7
0.8
0.9
1
1.1
1.2
1.3
1.4
1.5
(Thousands)
Elapsed Time
TW1C
TW2C
TW3C
TW4C
TW5C
TW6C

Figure B-17

Temperature Outside the Heated Array

(Depth of 12 ft)

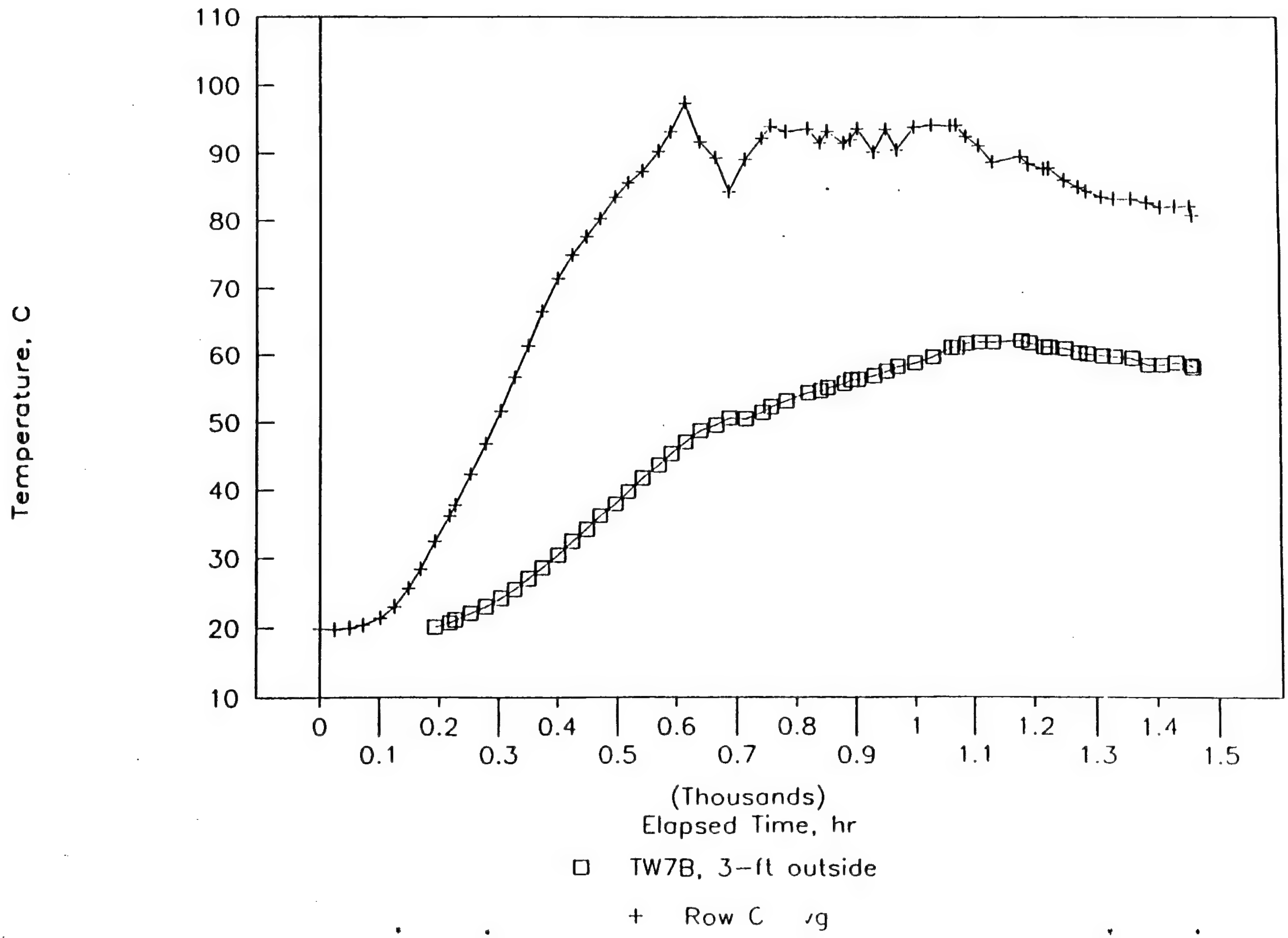


Figure B-18

Temperature Outside the Heated Array

(Depth of 24 ft)

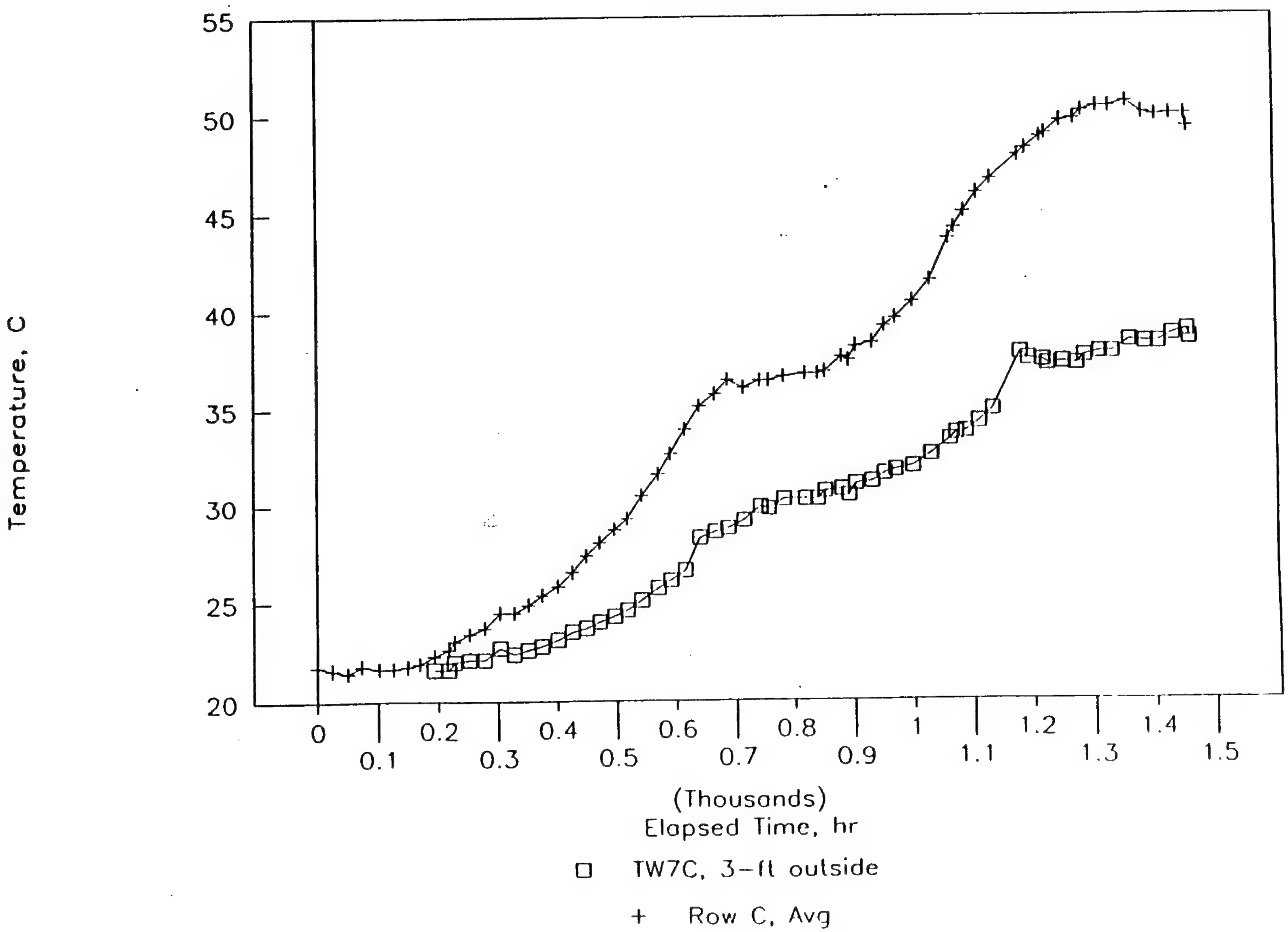
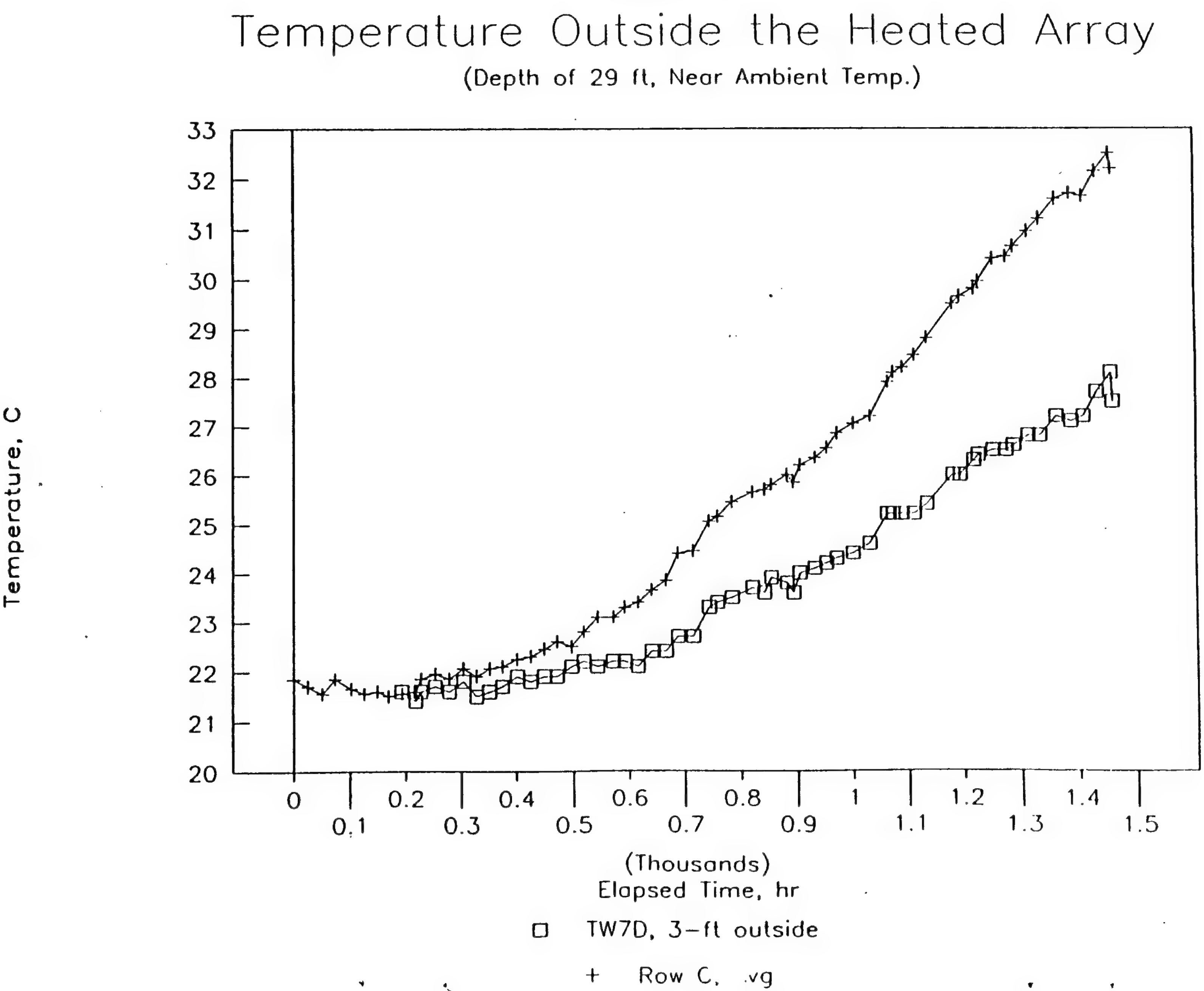


Figure B-19



Temperature Outside the Heated Array
(Depth of 29 ft, Near Ambient Temp.)
33
32
31
30
29
28
27
26
25
24
23
22
21
20
Temperature, C
0
0.1
0.2
0.3
0.4
0.5
0.6
0.7
0.8
0.9
1
1.1
1.2
1.3
1.4
1.5
(Thousands)
Elapsed Time, hr
TW7D, 3-ft outside
Row C, .vg

Figure B-20. Longitudinal Temperature Distribution in Plane LONG
(Depth: 1 ft)

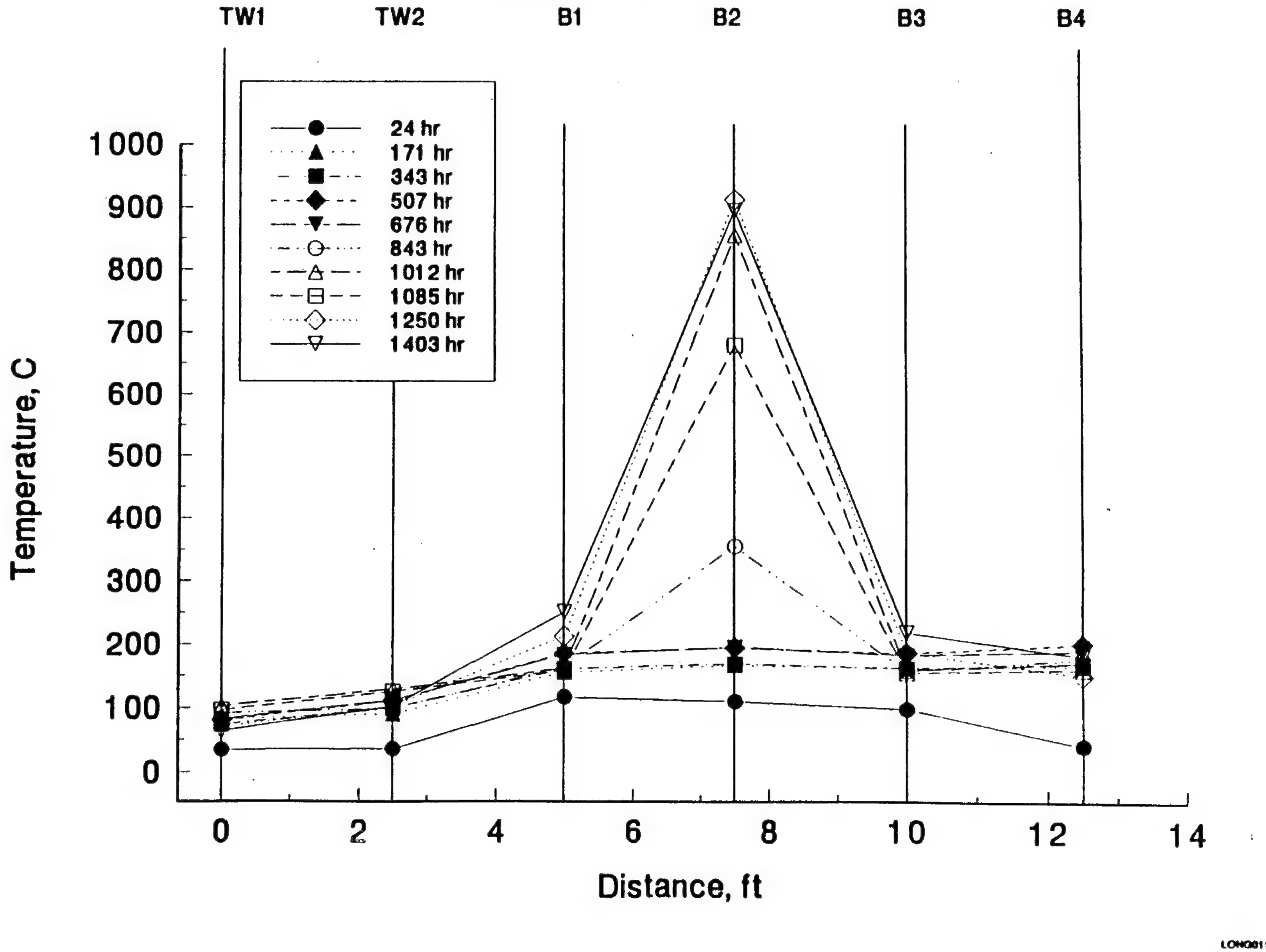


Figure B-21. Longitudinal Temperature Distribution in Plane LONG
(Depth: 10-12 ft)

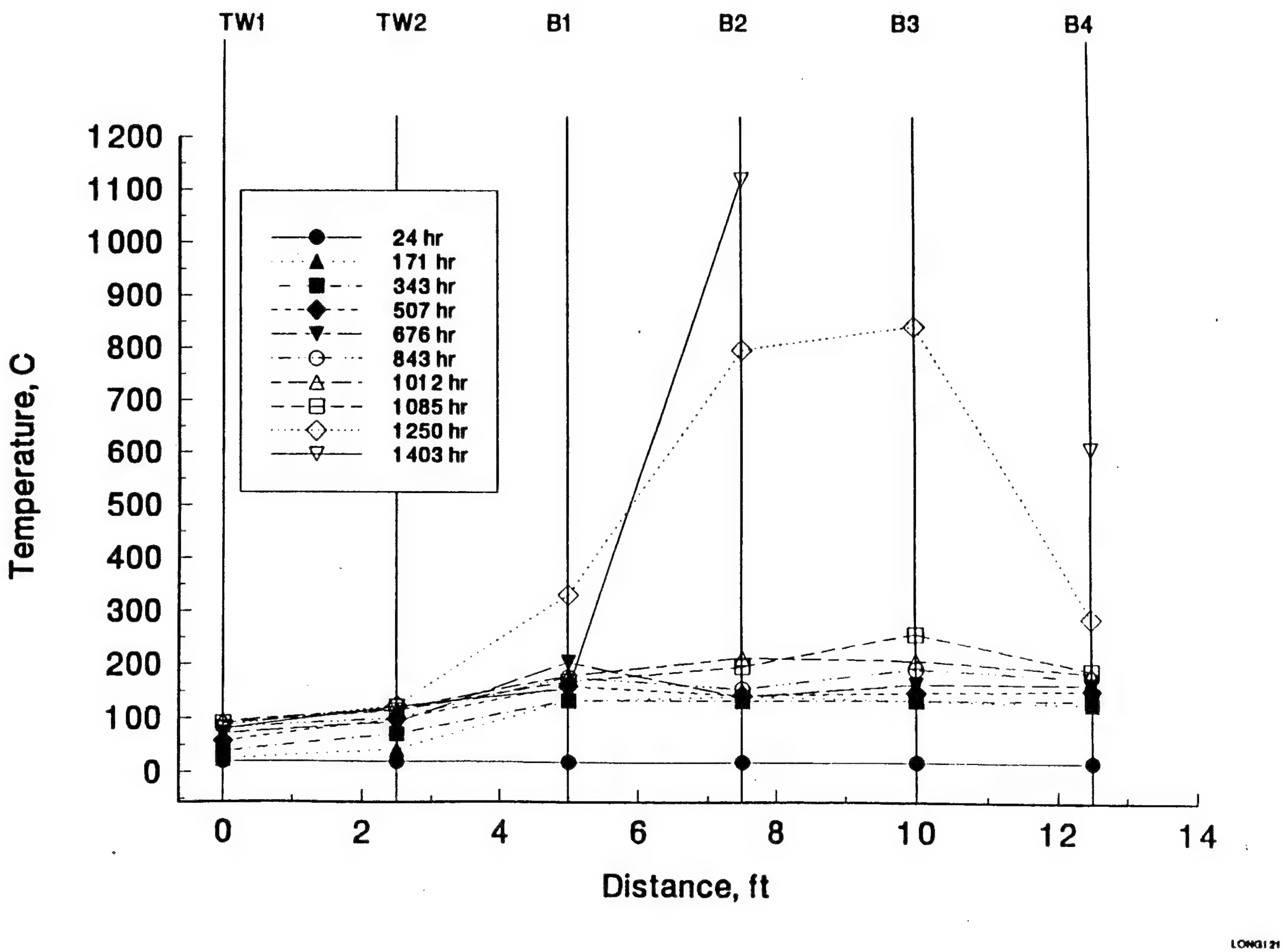


Figure B-22. Longitudinal Temperature Distribution in Plane LONG
(Depth: 20-24 ft)

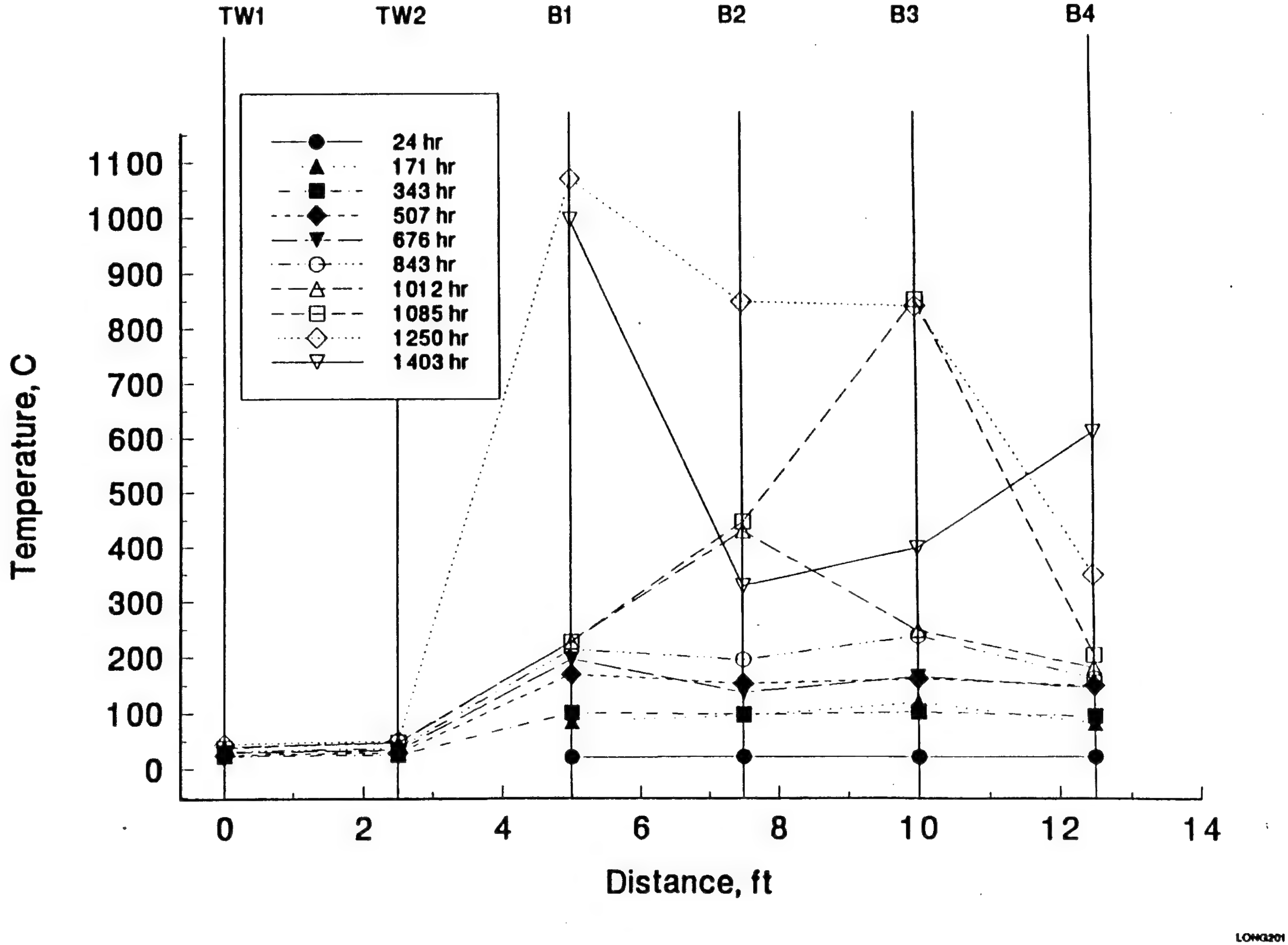


Figure B-23. Longitudinal Temperature Distribution in Plane LNGU

(Depth: 1 ft)

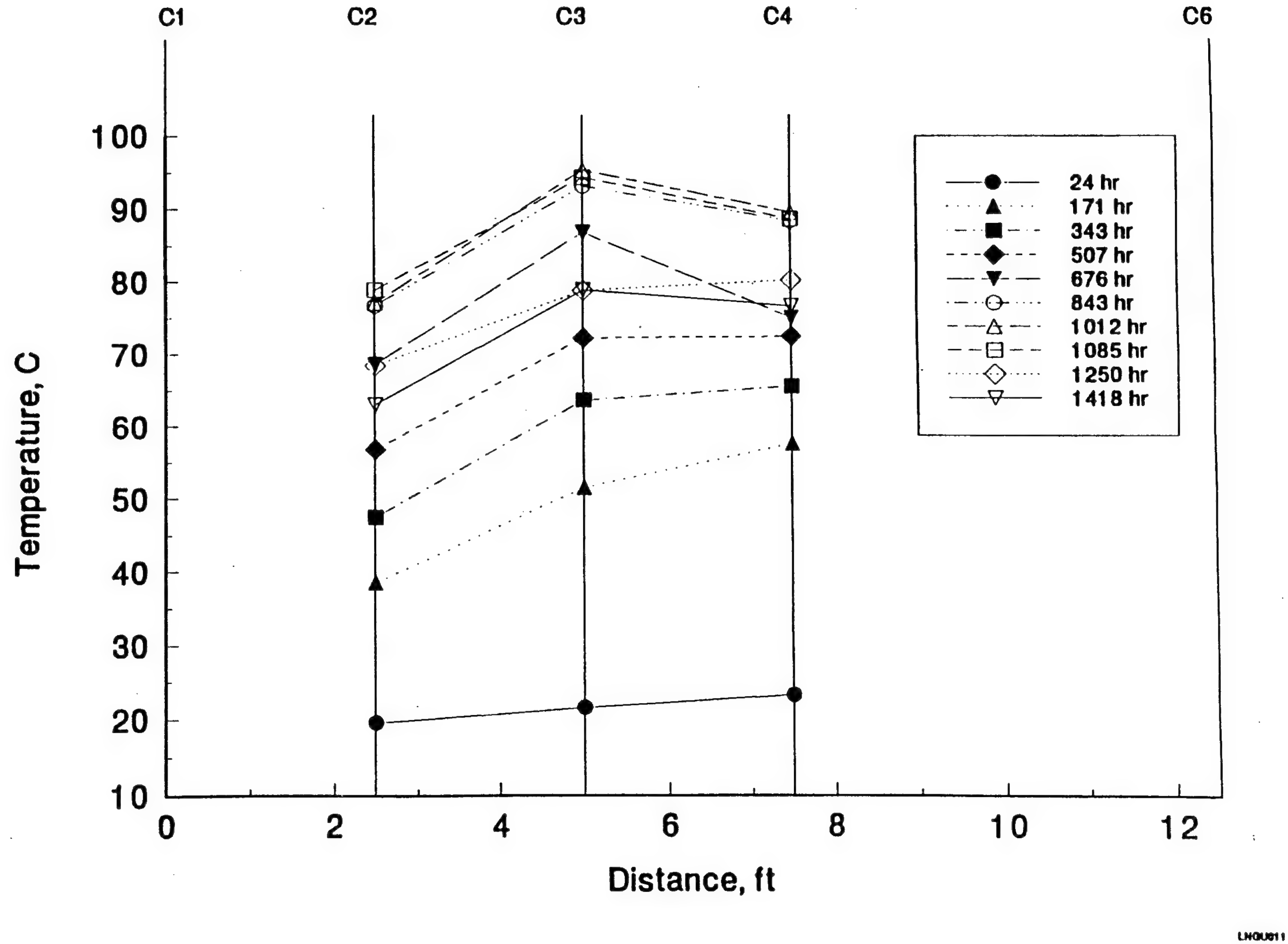


Figure B-24. Longitudinal Temperature Distribution in Plane LNGU

(Depth: 12 ft)

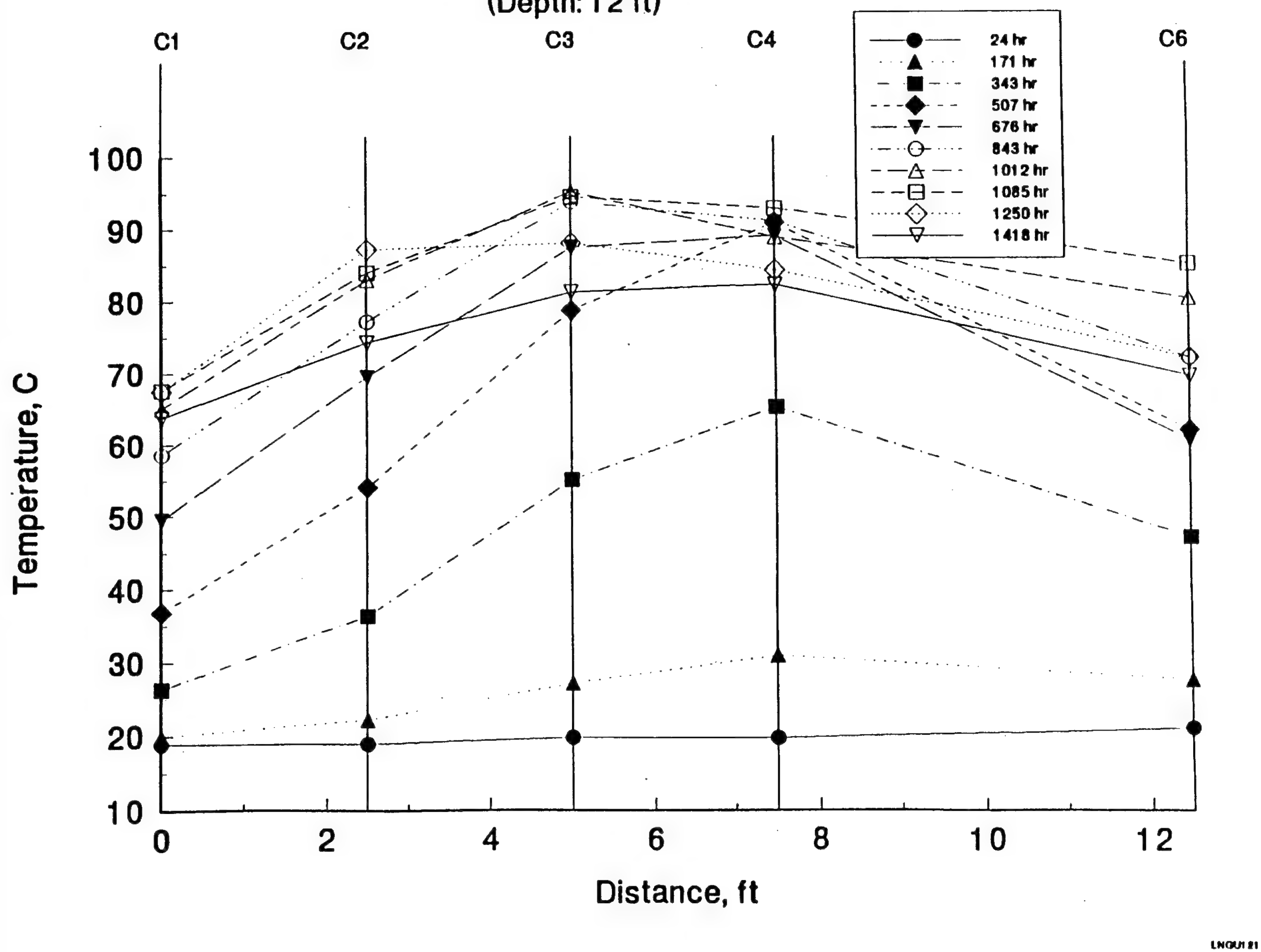


Figure B-25. Longitudinal Temperature Distribution in Plane LNGU
(Depth: 24 ft)

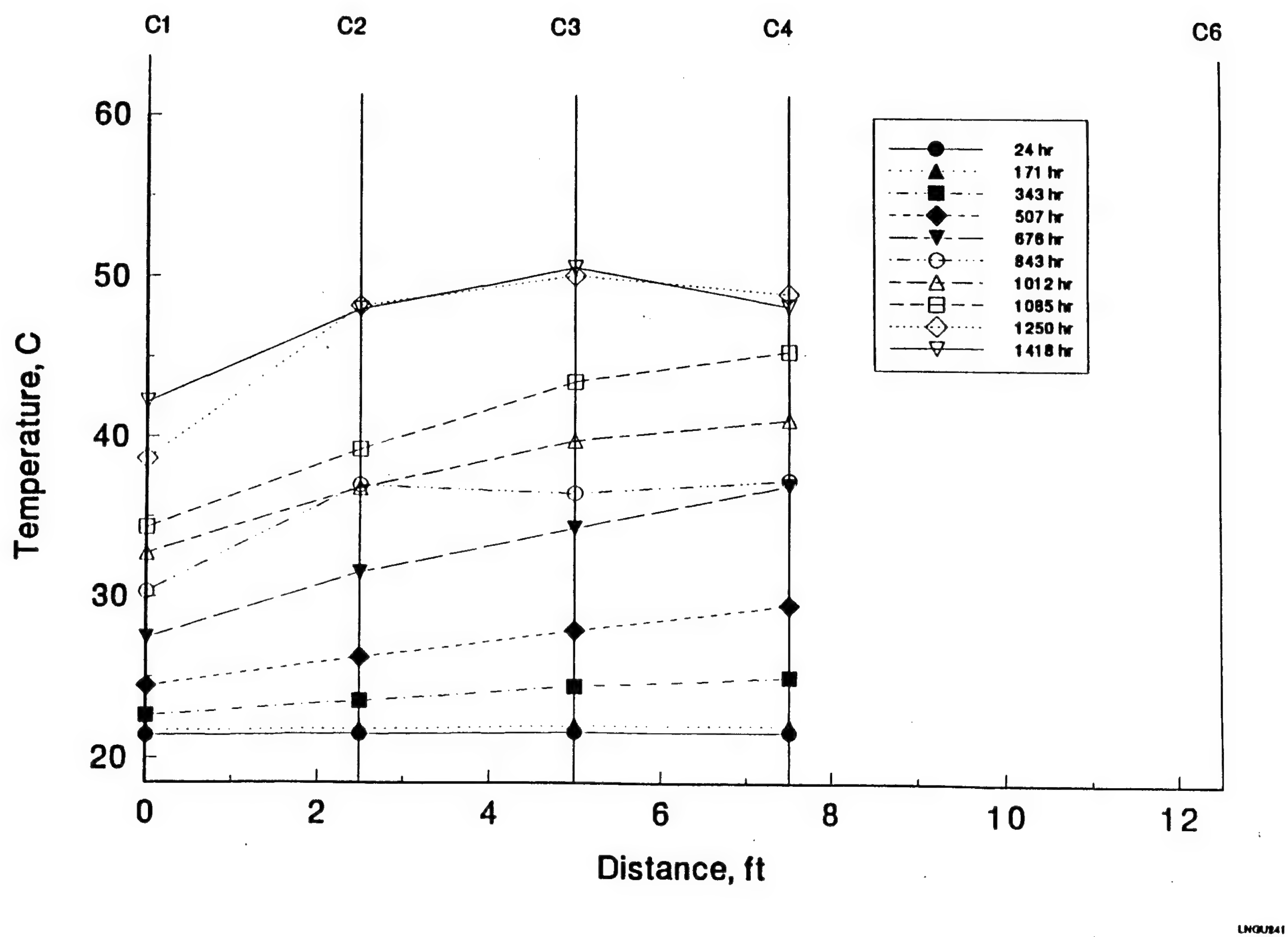


Figure B-26. Transverse Temperature Distribution in Plane TRNV

(Depth: 1 ft)

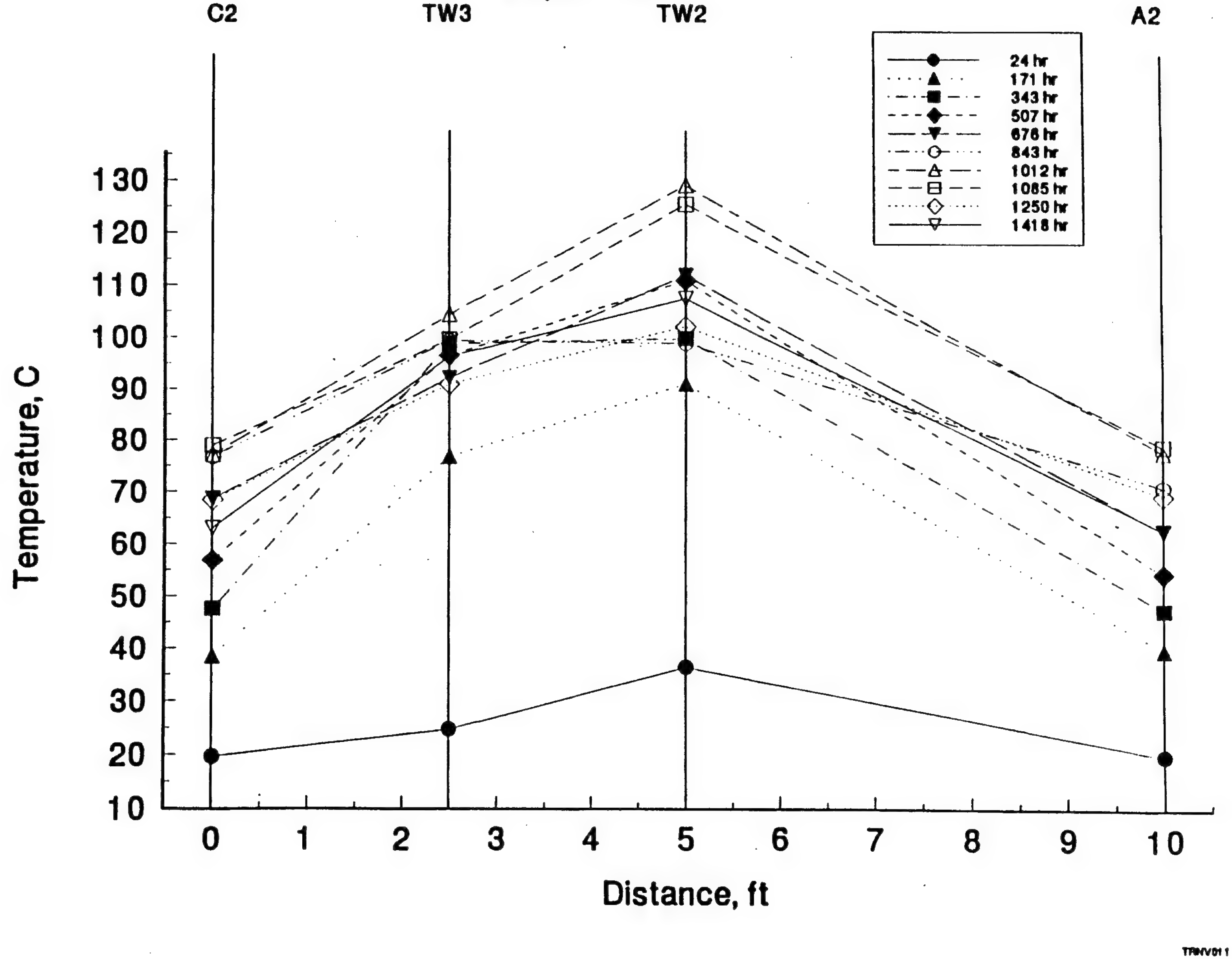


Figure B-27. Transverse Temperature Distribution in Plane TRNV

(Depth: 12 ft)

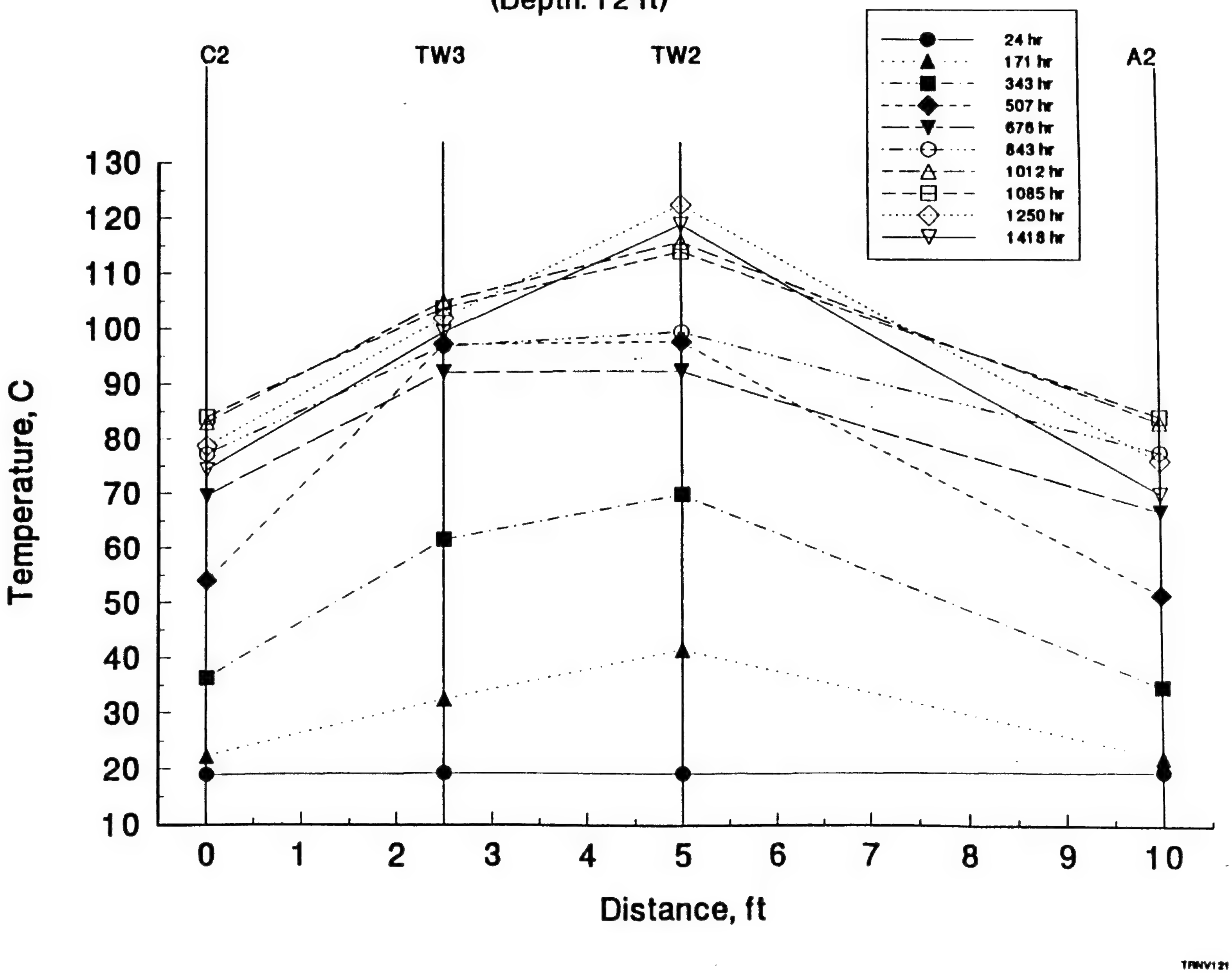


Figure B-28. Transverse Temperature Distribution in Plane TRNV

(Depth: 24 ft)

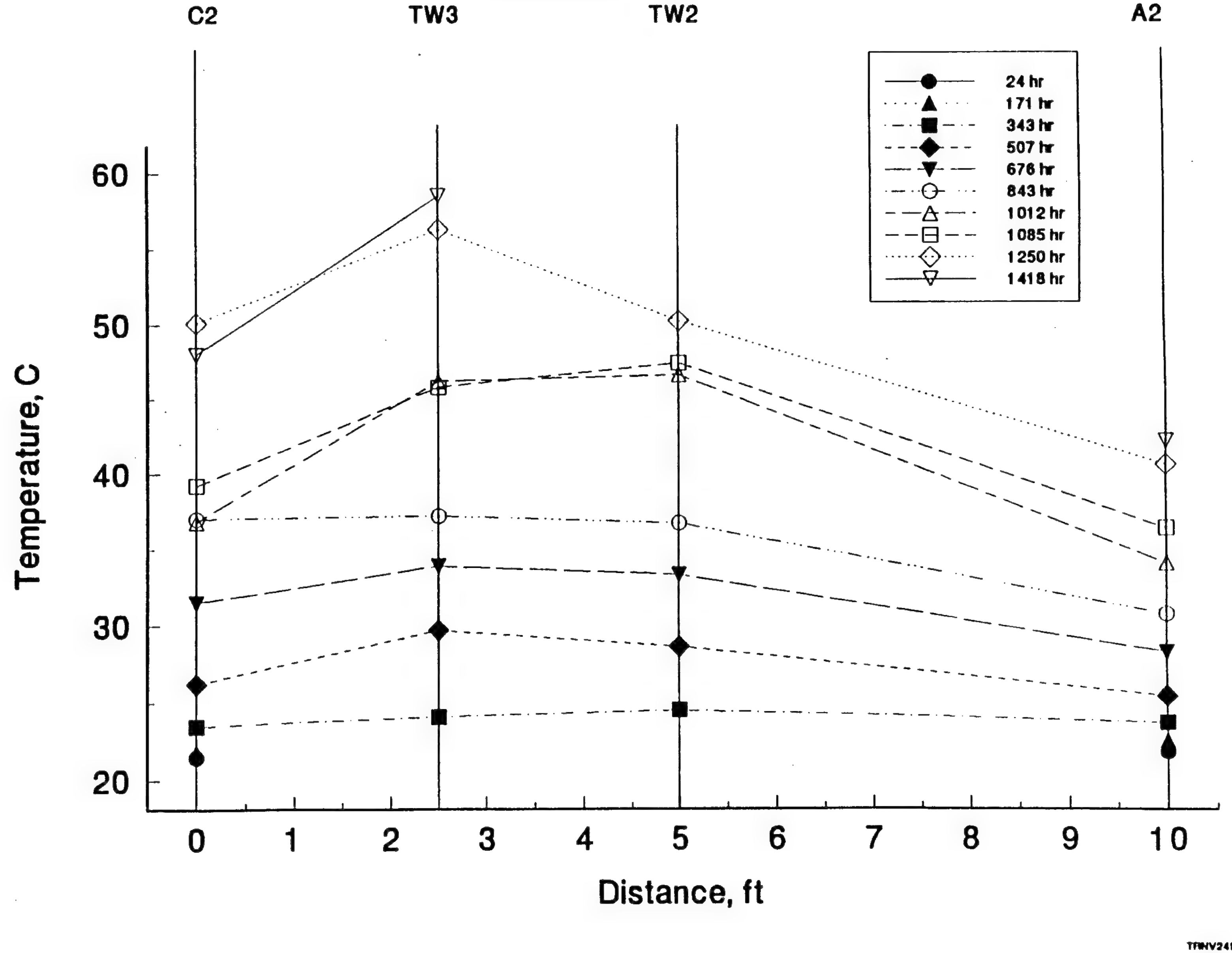


Figure B-29. Transverse Temperature Distribution in Plane TRNS
(Depth: 1 ft)

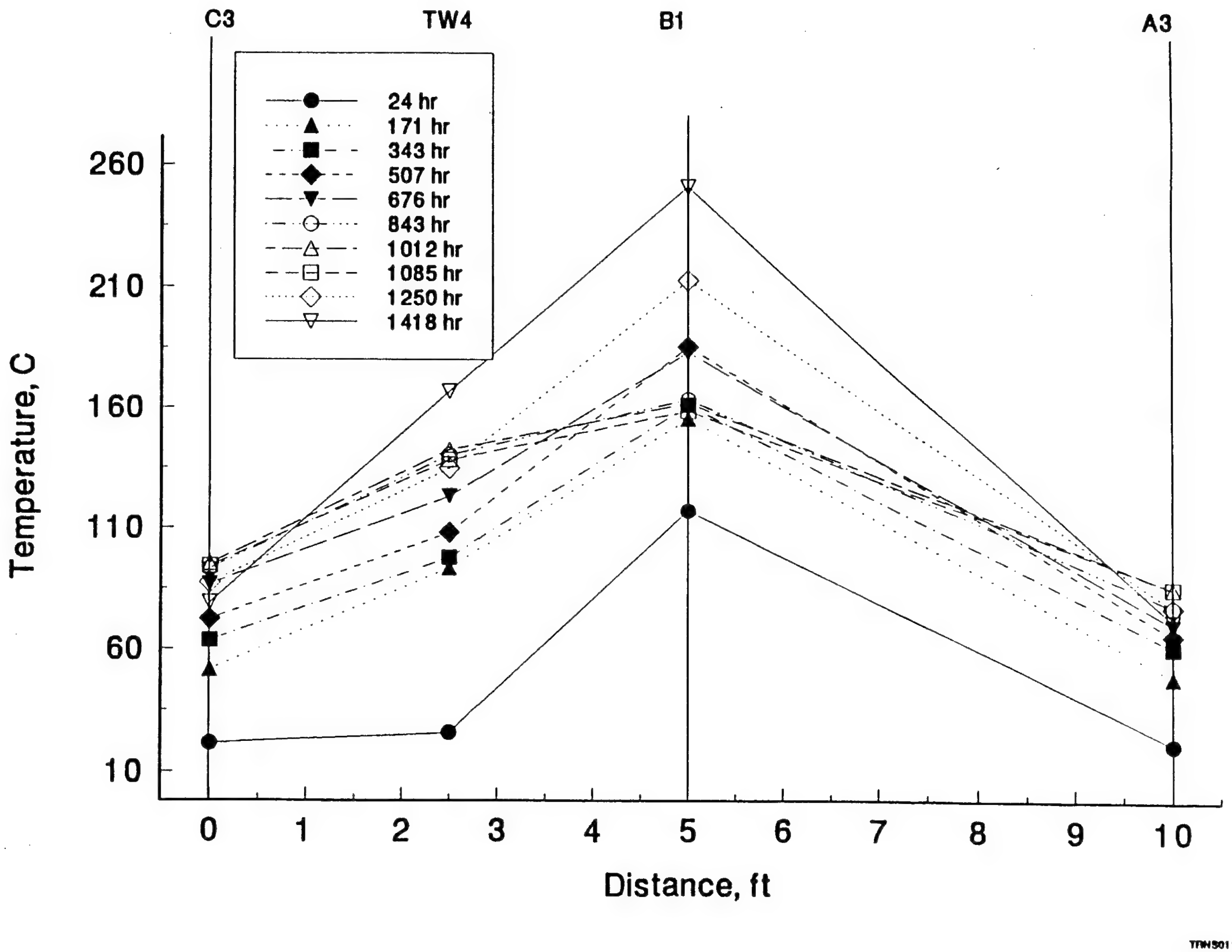
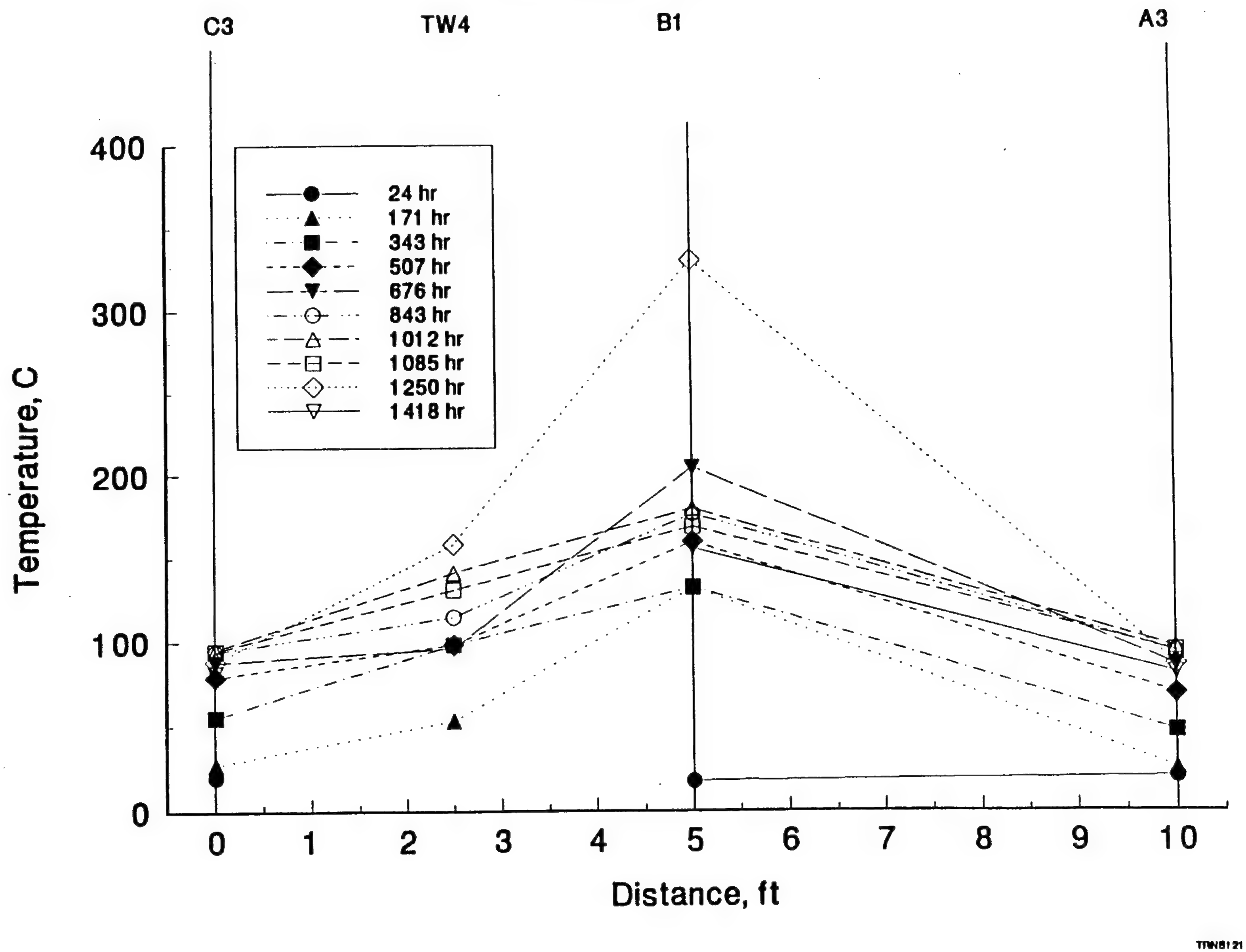


Figure B-30. Transverse Temperature Distribution in Plane TRNS
(Depth: 10-12 ft)



APPENDIX C

ELECTRICAL DATA

APPENDIX C

ELECTRICAL DATA

The electrical data and logbook entries regarding the performance of the RF power source and other observations concerning the load are summarized in this memo. Detailed information is available in the log-books. There are two tables entitled: Operating Data -- Electrical and Summary of Log Book Entries.

The table entitled Operating Data -- Electrical provides the electrical operating data for the heating experiment. The following data are tabulated:

- Date and Time
- Forward and Reflected power as measured at the array
- Net input power obtained as the difference of the forward and reflected power measured at the array
- Elapsed time in hours from the beginning of the experiment
- Equivalent days of operation at 40-kW.
- Elapsed calendar days of operation
- Power source utilization factor, percent; found by dividing equivalent days at 40-kW by the calendar days.
- VSWR estimated by equation (1) below. Also see Note 1 below.
- Vector Voltmeter readings, Va and Vb in mV.
- Magnitude of impedance calculated from equation (2) below
- Phase angle as measured by the vector voltmeter
- Magnitude of real and imaginary portions of the impedance as calculated by Equations (3a) and (3b) below.

$$VSWR = \frac{1 + \sqrt{\frac{Refl}{Forward}}}{1 - \sqrt{\frac{Refl}{Forward}}} \tag{1}$$

$$Z,\ ohms = 31.98\left(\frac{Va}{Vb}\right) \tag{2}$$

$$Z_{real} = Z\cos\left(\frac{\pi}{180}(-\phi)\right) \tag{3a}$$

$$Z_{img} = Z\sin\left(\frac{\pi}{180}(-\phi)\right) \tag{3b}$$

where:

Refl:	Reflected power measured at array
Forward:	Forward power measured at array
ϕ:	phase angle measured by Vector voltmeter
Va, Vb:	Vector voltmeter readings, mV

NOTE 1: On May 22, it was observed that there was a large discrepancy between the net input power as measured at the array versus that measured at the power source. This is marked on page 22 of the table containing electrical data (between two horizontal lines). From this point onwards, the forward and reflected data tabulated in this table is from measurements made at the power source. Due to this reason, subsequent VSWR calculations are 1 or very close to 1 unless there was significant reflected power at the power source.

Table C-1 Operating Data -- Electrical

DATE	TIME hr	TIME mi	Power at Array in kW Forw.	Power at Array in kW Refl.	Input Power in kW	Elapsed Time hours	Equiv. Days at 40 kW	Elapsed Days	Source Utilization %	VSWR	Vector Voltmeter Va mV	Vector Voltmeter Vb mV	Z ohm	Angle degree	Z Real	Z Imaginary
03-Apr	16	40	10.5	4.5	6.00	0.0	0.0	0.0		4.8	13.0	9.2	45.2	-70.5	15.1	42.6
03-Apr	20	4	10.6	4.5	6.10	3.4	0.0	0.1	15	4.7	13.0	9.2	45.2	-70.7	14.9	42.6
03-Apr	20	5	0.0	0.0	0.00	3.4	0.0	0.1	15	ERR			ERR		ERR	ERR
03-Apr	22	45	0.0	0.0	0.00	6.1	0.0	0.3	8	ERR			ERR		ERR	ERR
03-Apr	22	46	9.9	4.2	5.70	6.1	0.0	0.3	8	4.7	12.5	8.9	44.9	-70.2	15.2	42.3
04-Apr	2	50	10.0	4.4	5.60	10.2	0.0	0.4	11	4.9			ERR		ERR	ERR
04-Apr	2	51	0.0	0.0	0.00	10.2	0.0	0.4	11	ERR			ERR		ERR	ERR
04-Apr	3	10	0.0	0.0	0.00	10.5	0.0	0.4	10	ERR			ERR		ERR	ERR
04-Apr	3	11	10.0	4.4	5.60	10.5	0.0	0.4	10	4.9			ERR		ERR	ERR
04-Apr	8	39	11.0	4.6	6.40	16.0	0.1	0.7	12	4.7	12.6	9.3	43.3	-71.9	13.5	41.2
04-Apr	8	40	0.0	0.0	0.00	16.0	0.1	0.7	12	ERR			ERR		ERR	ERR
04-Apr	8	54	0.0	0.0	0.00	16.2	0.1	0.7	12	ERR			ERR		ERR	ERR
04-Apr	8	55	19.1	8.2	10.90	16.3	0.1	0.7	12	4.8	17.1	12.5	43.7	-71.9	13.6	41.6
04-Apr	10	29	19.8	9.0	10.80	17.8	0.1	0.7	13	5.1			ERR		ERR	ERR
04-Apr	10	30	0.0	0.0	0.00	17.8	0.1	0.7	13	ERR			ERR		ERR	ERR
04-Apr	10	39	0.0	0.0	0.00	18.0	0.1	0.7	13	ERR	16.9	12.5	43.2	-71.9	13.4	41.1
04-Apr	10	40	20.0	9.0	11.00	18.0	0.1	0.8	13	5.1			ERR		ERR	ERR
04-Apr	14	29	19.8	8.8	11.00	21.8	0.1	0.9	16	5.0			ERR		ERR	ERR
04-Apr	14	30	0.0	0.0	0.00	21.8	0.1	0.9	16	ERR	17.1	12.6	43.4	-72.2	13.3	41.3
04-Apr	14	44	0.0	0.0	0.00	22.1	0.1	0.9	15	ERR			ERR		ERR	ERR
04-Apr	14	45	20.0	9.0	11.00	22.1	0.1	0.9	15	5.1			ERR		ERR	ERR
04-Apr	15	29	20.0	9.0	11.00	22.8	0.2	1.0	16	5.1			ERR		ERR	ERR
04-Apr	15	30	41.5	19.0	22.50	22.8	0.2	1.0	16	5.2	25.7	18.8	43.7	-71.8	13.7	41.5
04-Apr	16	59	43.0	19.0	24.00	24.3	0.2	1.0	18	5.0			ERR		ERR	ERR
04-Apr	17	0	0.0	0.0	0.00	24.3	0.2	1.0	18	ERR			ERR		ERR	ERR
04-Apr	17	5	0.0	0.0	0.00	24.4	0.2	1.0	18	ERR	25.8	18.9	43.7	-71.6	13.8	41.4
04-Apr	17	6	43.0	19.0	24.00	24.4	0.2	1.0	18	5.0			ERR		ERR	ERR
04-Apr	18	59	41.0	17.5	23.50	26.3	0.2	1.1	21	4.8	25.6	18.2	45.0	-70.4	15.1	42.4

Table C-1 Operating Data -- Electrical (Continued)

DATE	TIME hr	TIME mi	Power at Array in kW Forw.	Power at Array in kW Refl.	Input Power in kW	Elapsed Time hours	Equiv. Days at 40 kW	Elapsed Days	Source Utilization %	VSWR	Vector Voltmeter Va mV	Vector Voltmeter Vb mV	Z ohm	Angle degree	Z Real	Z Imaginary
05-Apr	8	59	33.0	10.8	22.20	40.3	0.5	1.7	32	3.7			ERR		ERR	ERR
05-Apr	9	0	0.0	0.0	0.00	40.3	0.5	1.7	32	ERR	22.1	15.5	45.6	-68.8	16.5	42.5
05-Apr	9	9	0.0	0.0	0.00	40.5	0.5	1.7	32	ERR			ERR		ERR	ERR
05-Apr	9	10	33.0	10.8	22.20	40.5	0.5	1.7	32	3.7			ERR		ERR	ERR
05-Apr	10	5	33.0	10.8	22.20	41.4	0.6	1.7	33	3.7			ERR		ERR	ERR
05-Apr	10	15	49.0	15.0	34.00	41.6	0.6	1.7	33	3.5	27.5	18.5	47.5	-67.6	18.1	44.0
05-Apr	10	59	49.0	15.0	34.00	42.3	0.6	1.8	34	3.5			ERR		ERR	ERR
05-Apr	11	0	0.0	0.0	0.00	42.3	0.6	1.8	34	ERR	27.6	18.3	48.2	-67.1	18.8	44.4
05-Apr	11	21	0.0	0.0	0.00	42.7	0.6	1.8	34	ERR			ERR		ERR	ERR
05-Apr	11	22	52.0	16.2	35.80	42.7	0.6	1.8	34	3.5	27.8	18.7	47.5	67.9	17.9	-44.0
05-Apr	12	59	50.0	14.0	36.00	44.3	0.7	1.8	36	3.2			ERR		ERR	ERR
05-Apr	13	0	0.0	0.0	0.00	44.3	0.7	1.8	36	ERR	27.2	17.8	48.9	-66.1	19.8	44.7
05-Apr	13	9	0.0	0.0	0.00	44.5	0.7	1.9	36	ERR			ERR		ERR	ERR
05-Apr	13	10	50.0	14.0	36.00	44.5	0.7	1.9	36	3.2			ERR		ERR	ERR
05-Apr	14	59	44.8	11.9	32.90	46.3	0.7	1.9	38	3.1			ERR		ERR	ERR
05-Apr	15	0	0.0	0.0	0.00	46.3	0.7	1.9	38	ERR	26.2	17.2	48.7	-63.0	22.1	43.4
05-Apr	15	9	0.0	0.0	0.00	46.5	0.7	1.9	37	ERR			ERR		ERR	ERR
05-Apr	15	10	44.8	11.9	32.90	46.5	0.7	1.9	37	3.1			ERR		ERR	ERR
05-Apr	15	59	44.8	11.9	32.90	47.3	0.8	2.0	38	3.1			ERR		ERR	ERR
05-Apr	16	0	0.0	0.0	0.00	47.3	0.8	2.0	38	ERR			ERR		ERR	ERR
05-Apr	16	19	0.0	0.0	0.00	47.7	0.8	2.0	38	ERR			ERR		ERR	ERR
05-Apr	16	20	46.0	12.0	34.00	47.7	0.8	2.0	38	3.1	26.0	17.5	47.5	-63.3	21.3	42.4
05-Apr	17	59	46.0	12.0	34.00	49.3	0.8	2.1	40	3.1			ERR		ERR	ERR
05-Apr	18	0	0.0	0.0	0.00	49.3	0.8	2.1	40	ERR	24.9	15.7	50.7	-52.6	30.8	40.3
05-Apr	18	5	0.0	0.0	0.00	49.4	0.8	2.1	39	ERR			ERR		ERR	ERR
05-Apr	18	6	42.0	8.5	33.50	49.4	0.8	2.1	39	2.6			ERR		ERR	ERR
05-Apr	19	59	42.0	8.5	33.50	51.3	0.9	2.1	41	2.6			ERR		ERR	ERR
05-Apr	20	0	0.0	0.0	0.00	51.3	0.9	2.1	41	ERR			ERR		ERR	ERR

Table C-1 Operating Data -- Electrical (Continued)

DATE	TIME hr	TIME mi	Power at Array in kW Forw.	Power at Array in kW Refl.	Input Power in kW	Elapsed Time hours	Equiv. Days at 40 kW	Elapsed Days	Source Utilization %	VSWR	Vector Voltmeter Va mV	Vector Voltmeter Vb mV	Z ohm	Angle degree	Z Real	Z Imaginary
05-Apr	20	5	0.0	0.0	0.00	51.4	0.9	2.1	41	ERR			ERR		ERR	ERR
05-Apr	20	6	42.0	8.5	33.50	51.4	0.9	2.1	41	2.6			ERR		ERR	ERR
05-Apr	21	59	42.0	8.5	33.50	53.3	0.9	2.2	43	2.6			ERR		ERR	ERR
05-Apr	22	0	0.0	0.0	0.00	53.3	0.9	2.2	43	ERR			ERR		ERR	ERR
05-Apr	22	49	0.0	0.0	0.00	54.2	0.9	2.3	42	ERR			ERR		ERR	ERR
05-Apr	22	50	52.0	10.0	42.00	54.2	0.9	2.3	42	2.6	28.6	18.2	50.3	-52.7	30.5	40.0
05-Apr	23	59	52.0	10.0	42.00	55.3	1.0	2.3	43	2.6	28.7	18.0	51.0	-53.0	30.7	40.7
06-Apr	0	0	0.0	0.0	0.00	55.3	1.0	2.3	43	ERR			ERR		ERR	ERR
06-Apr	0	15	0.0	0.0	0.00	55.6	1.0	2.3	43	ERR			ERR		ERR	ERR
06-Apr	0	16	52.0	10.0	42.00	55.6	1.0	2.3	43	2.6			ERR		ERR	ERR
06-Apr	1	59	52.0	10.0	42.00	57.3	1.1	2.4	45	2.6			ERR		ERR	ERR
06-Apr	2	0	0.0	0.0	0.00	57.3	1.1	2.4	45	ERR	28.6	17.7	51.7	-52.0	31.8	40.7
06-Apr	2	10	0.0	0.0	0.00	57.5	1.1	2.4	45	ERR			ERR		ERR	ERR
06-Apr	2	11	52.0	10.0	42.00	57.5	1.1	2.4	45	2.6			ERR		ERR	ERR
06-Apr	3	59	50.0	9.0	41.00	59.3	1.1	2.5	47	2.5			ERR		ERR	ERR
06-Apr	4	0	0.0	0.0	0.00	59.3	1.2	2.5	47	ERR	27.8	17.5	50.8	-50.5	32.3	39.2
06-Apr	4	15	0.0	0.0	0.00	59.6	1.2	2.5	46	ERR			ERR		ERR	ERR
06-Apr	4	16	50.0	9.0	41.00	59.6	1.2	2.5	46	2.5			ERR		ERR	ERR
06-Apr	5	59	50.0	8.2	41.80	61.3	1.2	2.6	48	2.4			ERR		ERR	ERR
06-Apr	6	0	0.0	0.0	0.00	61.3	1.2	2.6	48	ERR	27.5	17.5	50.3	-49.2	32.8	38.0
06-Apr	6	15	0.0	0.0	0.00	61.6	1.2	2.6	48	ERR			ERR		ERR	ERR
06-Apr	6	16	50.0	8.2	41.80	61.6	1.2	2.6	48	2.4			ERR		ERR	ERR
06-Apr	7	59	48.0	8.2	39.80	63.3	1.3	2.6	49	2.4			ERR		ERR	ERR
06-Apr	8	0	0.0	0.0	0.00	63.3	1.3	2.6	49	ERR	26.5	17.3	49.0	-47.5	33.1	36.1
06-Apr	8	10	0.0	0.0	0.00	63.5	1.3	2.6	49	ERR			ERR		ERR	ERR
06-Apr	8	11	48.0	8.2	39.80	63.5	1.3	2.6	49	2.4			ERR		ERR	ERR
06-Apr	9	59	48.0	7.2	40.80	65.3	1.4	2.7	51	2.3			ERR		ERR	ERR
06-Apr	10	0	0.0	0.0	0.00	65.3	1.4	2.7	51	ERR	25.7	17.0	48.3	-46.4	33.3	35.0

Table C-1 Operating Data -- Electrical (Continued)

DATE	TIME hr	TIME mi	Power at Array in kW Forw.	Power at Array in kW Refl.	Input Power in kW	Elapsed Time hours	Equiv. Days at 40 kW	Elapsed Days	Source Utilization %	VSWR	Vector Voltmeter Va mV	Vector Voltmeter Vb mV	Z ohm	Angle degree	Z Real	Z Imaginary
06-Apr	10	8	0.0	0.0	0.00	65.5	1.4	2.7	50	ERR			ERR		ERR	ERR
06-Apr	10	9	48.0	7.2	40.80	65.5	1.4	2.7	50	2.3			ERR		ERR	ERR
06-Apr	11	59	46.5	6.5	40.00	67.3	1.5	2.8	52	2.2			ERR		ERR	ERR
06-Apr	12	0	0.0	0.0	0.00	67.3	1.5	2.8	52	ERR	25.5	16.2	50.3	−45.4	35.3	35.8
06-Apr	12	9	0.0	0.0	0.00	67.5	1.5	2.8	52	ERR			ERR		ERR	ERR
06-Apr	12	10	46.5	6.5	40.00	67.5	1.5	2.8	52	2.2			ERR		ERR	ERR
06-Apr	14	39	46.5	6.5	40.00	70.0	1.6	2.9	53	2.2			ERR		ERR	ERR
06-Apr	14	40	0.0	0.0	0.00	70.0	1.6	2.9	53	ERR			ERR		ERR	ERR
06-Apr	14	50	0.0	0.0	0.00	70.2	1.6	2.9	53	ERR			ERR		ERR	ERR
06-Apr	14	51	46.0	6.8	39.20	70.2	1.6	2.9	53	2.2	24.3	16.5	47.1	−44.9	33.4	33.2
06-Apr	15	30	45.0	6.5	38.50	70.8	1.6	3.0	54	2.2	25.3	16.3	49.6	−43.7	35.9	34.3
06-Apr	17	59	45.0	6.5	38.50	73.3	1.7	3.1	55	2.2			ERR		ERR	ERR
06-Apr	18	0	0.0	0.0	0.00	73.3	1.7	3.1	55	ERR			ERR		ERR	ERR
06-Apr	18	5	0.0	0.0	0.00	73.4	1.7	3.1	55	ERR			ERR		ERR	ERR
06-Apr	18	6	45.0	6.5	38.50	73.4	1.7	3.1	55	2.2			ERR		ERR	ERR
06-Apr	21	59	45.0	6.5	38.50	77.3	1.8	3.2	57	2.2	25.2	16.4	49.1	−44.5	35.0	34.4
06-Apr	22	0	0.0	0.0	0.00	77.3	1.8	3.2	57	ERR			ERR		ERR	ERR
06-Apr	22	5	0.0	0.0	0.00	77.4	1.8	3.2	57	ERR			ERR		ERR	ERR
06-Apr	22	6	45.0	6.5	38.50	77.4	1.8	3.2	57	2.2			ERR		ERR	ERR
07-Apr	1	59	45.0	6.5	38.50	81.3	2.0	3.4	59	2.2			ERR		ERR	ERR
07-Apr	2	0	0.0	0.0	0.00	81.3	2.0	3.4	59	ERR	25.2	16.6	48.5	−44.5	34.6	34.0
07-Apr	2	10	0.0	0.0	0.00	81.5	2.0	3.4	59	ERR			ERR		ERR	ERR
07-Apr	2	11	46.0	6.5	39.50	81.5	2.0	3.4	59	2.2			ERR		ERR	ERR
07-Apr	5	59	46.0	6.4	39.60	85.3	2.2	3.6	61	2.2			ERR		ERR	ERR
07-Apr	6	0	0.0	0.0	0.00	85.3	2.2	3.6	61	ERR	25.0	16.7	47.9	944.2	−34.3	33.4
07-Apr	6	7	0.0	0.0	0.00	85.5	2.2	3.6	60	ERR			ERR		ERR	ERR
07-Apr	6	8	46.0	6.5	39.50	85.5	2.2	3.6	60	2.2			ERR		ERR	ERR
07-Apr	8	29	46.0	6.6	39.40	87.8	2.3	3.7	61	2.2			ERR		ERR	ERR

Table C-1 Operating Data -- Electrical (Continued)

DATE	TIME hr	TIME mi	Power at Array in kW Forw.	Power at Array in kW Refl.	Input Power in kW	Elapsed Time hours	Equiv. Days at 40 kW	Elapsed Days	Source Utilization %	VSWR	Vector Voltmeter Va mV	Vector Voltmeter Vb mV	Z ohm	Angle degree	Z Real	Z Imaginary
07-Apr	8	30	0.0	0.0	0.00	87.8	2.3	3.7	61	ERR			ERR		ERR	ERR
07-Apr	8	36	0.0	0.0	0.00	87.9	2.3	3.7	61	ERR			ERR		ERR	ERR
07-Apr	8	37	46.0	6.6	39.40	88.0	2.3	3.7	61	2.2	24.7	16.7	47.3	−44.9	33.5	33.4
07-Apr	13	4	46.0	6.6	39.40	92.4	2.4	3.9	63	2.2			ERR		ERR	ERR
07-Apr	13	5	0.0	0.0	0.00	92.4	2.4	3.9	63	ERR			ERR		ERR	ERR
07-Apr	13	14	0.0	0.0	0.00	92.6	2.4	3.9	63	ERR			ERR		ERR	ERR
07-Apr	13	15	48.2	7.5	40.70	92.6	2.4	3.9	63	2.3	25.7	16.8	48.9	−47.6	33.0	36.1
07-Apr	14	35	47.2	7.5	39.70	93.9	2.5	3.9	64	2.3	25.4	16.5	49.2	−47.9	33.0	36.5
07-Apr	16	59	45.0	7.5	37.50	96.3	2.6	4.0	64	2.4			ERR		ERR	ERR
07-Apr	17	0	0.0	0.0	0.00	96.3	2.6	4.0	64	ERR			ERR		ERR	ERR
07-Apr	17	7	0.0	0.0	0.00	96.5	2.6	4.0	64	ERR	25.4	16.4	49.5	−47.3	33.6	36.4
07-Apr	17	8	45.0	7.5	37.50	96.5	2.6	4.0	64	2.4			ERR		ERR	ERR
07-Apr	19	15	45.9	7.2	38.70	98.6	2.7	4.1	65	2.3	25.6	16.2	50.5	−46.7	34.7	36.8
07-Apr	21	52	46.2	7.0	39.20	101.2	2.8	4.2	66	2.3	25.9	16.2	51.1	−46.1	35.5	36.8
07-Apr	21	57	46.2	7.0	39.20	101.3	2.8	4.2	66	2.3			ERR		ERR	ERR
07-Apr	21	58	0.0	0.0	0.00	101.3	2.8	4.2	66	ERR			ERR		ERR	ERR
07-Apr	22	2	0.0	0.0	0.00	101.4	2.8	4.2	66	ERR			ERR		ERR	ERR
07-Apr	22	3	46.2	7.0	39.20	101.4	2.8	4.2	66	2.3	26.0	16.2	51.3	−46.6	35.3	37.3
08-Apr	2	44	46.2	7.0	39.20	106.1	3.0	4.4	67	2.3			ERR		ERR	ERR
08-Apr	2	45	0.0	0.0	0.00	106.1	3.0	4.4	67	ERR			ERR		ERR	ERR
08-Apr	3	29	0.0	0.0	0.00	106.8	3.0	4.5	67	ERR			ERR		ERR	ERR
08-Apr	3	30	46.0	6.5	39.50	106.8	3.0	4.5	67	2.2			ERR		ERR	ERR
08-Apr	5	59	46.0	6.5	39.50	109.3	3.1	4.6	68	2.2			ERR		ERR	ERR
08-Apr	6	0	0.0	0.0	0.00	109.3	3.1	4.6	68	ERR			ERR		ERR	ERR
08-Apr	6	7	0.0	0.0	0.00	109.5	3.1	4.6	67	ERR	28.0	15.5	57.8	−47.0	39.4	42.3
08-Apr	6	8	46.0	6.5	39.50	109.5	3.1	4.6	67	2.2			ERR		ERR	ERR
08-Apr	8	10	46.4	6.9	39.50	111.5	3.2	4.6	68	2.3	27.3	15.5	56.3	−48.4	37.4	42.1
08-Apr	11	0	47.0	7.0	40.00	114.3	3.3	4.8	69	2.3	27.1	15.3	56.6	−47.5	38.3	41.[illegible]

Table C-1 Operating Data -- Electrical (Continued)

DATE	TIME hr	TIME mi	Power at Array in kW Forw.	Power at Array in kW Refl.	Input Power in kW	Elapsed Time hours	Equiv. Days at 40 kW	Elapsed Days	Source Utilization %	VSWR	Vector Voltmeter Va mV	Vector Voltmeter Vb mV	Z ohm	Angle degree	Z Real	Z Imaginary
08-Apr	11	26	47.0	7.0	40.00	114.8	3.3	4.8	69	2.3			ERR		ERR	ERR
08-Apr	11	27	0.0	0.0	0.00	114.8	3.3	4.8	69	ERR			ERR		ERR	ERR
08-Apr	11	41	0.0	0.0	0.00	115.0	3.3	4.8	69	ERR			ERR		ERR	ERR
08-Apr	11	42	44.2	7.0	37.20	115.0	3.3	4.8	69	2.3	26.8	15.0	57.1	-48.1	38.2	42.5
08-Apr	13	30	46.5	7.0	39.50	116.8	3.4	4.9	69	2.3	27.3	15.2	57.4	-48.1	38.4	42.8
08-Apr	14	25	46.0	7.0	39.00	117.8	3.4	4.9	69	2.3	27.3	15.1	57.8	-48.1	38.6	43.0
08-Apr	15	44	46.0	7.0	39.00	119.1	3.5	5.0	70	2.3			ERR		ERR	ERR
08-Apr	15	45	0.0	0.0	0.00	119.1	3.5	5.0	70	ERR			ERR		ERR	ERR
08-Apr	15	59	0.0	0.0	0.00	119.3	3.5	5.0	70	ERR			ERR		ERR	ERR
08-Apr	16	0	45.0	7.2	37.80	119.3	3.5	5.0	70	2.3	27.6	15.2	58.1	-47.2	39.5	42.6
08-Apr	18	59	45.0	7.2	37.80	122.3	3.6	5.1	70	2.3			ERR		ERR	ERR
08-Apr	19	0	0	0	0	122.3	3.5	5.1	69	ERR			ERR		ERR	ERR
08-Apr	19	4	0	0	0	122.4	3.5	5.1	69	ERR			ERR		ERR	ERR
08-Apr	19	5	45.0	7.0	38.00	122.4	3.6	5.1	70	2.3	27.6	15.0	58.8	-47.2	40.0	43.2
09-Apr	0	29	45.0	7.0	38.00	127.8	3.8	5.3	71	2.3			ERR		ERR	ERR
09-Apr	0	30	0.0	0.0	0.00	127.8	3.7	5.3	69	ERR			ERR		ERR	ERR
09-Apr	2	0	0.0	0.0	0.00	129.3	3.5	5.4	65	ERR			ERR		ERR	ERR
09-Apr	2	1	48.0	7.0	41.00	129.4	3.7	5.4	68	2.2			ERR		ERR	ERR
09-Apr	4	0	48.0	7.0	41.00	131.3	3.9	5.5	72	2.2	28.7	15.2	60.4	-47.8	40.6	44.7
09-Apr	4	1	0.0	0.0	0.00	131.4	3.9	5.5	71	ERR			ERR		ERR	ERR
09-Apr	4	6	0.0	0.0	0.00	131.4	3.7	5.5	67	ERR			ERR		ERR	ERR
09-Apr	4	7	48.0	7.0	41.00	131.5	3.6	5.5	65	2.2			ERR		ERR	ERR
09-Apr	9	0	50.0	7.0	43.00	136.3	4.2	5.7	73	2.2	28.0	14.7	60.9	-48.4	40.4	45.6
09-Apr	10	55	48.0	7.0	41.00	138.3	4.3	5.8	74	2.2	27.5	14.4	61.1	-48.2	40.7	45.5
09-Apr	13	43	48.0	7.0	41.00	141.1	4.4	5.9	74	2.2			ERR		ERR	ERR
09-Apr	10	44	0.0	0.0	0.00	138.1	4.3	5.8	75	ERR	27.8	14.4	61.7	-48.4	41.0	46.2
09-Apr	10	53	0.0	0.0	0.00	138.2	4.3	5.8	75	ERR			ERR		ERR	ERR
09-Apr	10	55	48.0	7.0	41.00	138.3	4.3	5.8	75	2.2			ERR		ERR	ERR

Table C-1 Operating Data -- Electrical (Continued)

DATE	TIME hr	TIME mi	Power at Array in kW Forw.	Power at Array in kW Refl.	Input Power in kW	Elapsed Time hours	Equiv. Days at 40 kW	Elapsed Days	Source Utilization %	VSWR	Vector Voltmeter Va mV	Vector Voltmeter Vb mV	Z ohm	Angle degree	Z Real	Z Imaginary
09–Apr	14	14	48.0	7.0	41.00	141.6	4.4	5.9	74	2.2			ERR		ERR	ERR
09–Apr	14	15	0.0	0.0	0.00	141.6	4.3	5.9	73	ERR			ERR		ERR	ERR
09–Apr	14	29	0.0	0.0	0.00	141.8	4.4	5.9	74	ERR			ERR		ERR	ERR
09–Apr	14	30	48.0	6.9	41.10	141.8	4.3	5.9	73	2.2			ERR		ERR	ERR
09–Apr	17	33	46.5	6.8	39.70	144.9	4.5	6.0	74	2.2	27.4	14.4	60.9	−48.4	40.4	45.5
09–Apr	18	29	46.5	6.8	39.70	145.8	4.5	6.1	74	2.2			ERR		ERR	ERR
09–Apr	18	30	0.0	0.0	0.00	145.8	4.5	6.1	74	ERR			ERR		ERR	ERR
09–Apr	18	34	0.0	0.0	0.00	145.9	4.5	6.1	74	ERR			ERR		ERR	ERR
09–Apr	18	35	46.5	6.8	39.70	145.9	4.5	6.1	74	2.2			ERR		ERR	ERR
09–Apr	21	7	46.2	6.2	40.00	148.5	4.6	6.2	74	2.2	28.1	14.5	62.0	−47.7	41.7	45.8
09–Apr	23	0	46.2	6.2	40.00	150.3	4.7	6.3	75	2.2	28.4	14.5	62.6	−45.4	44.0	44.6
10–Apr	1	30	46.0	6.2	39.80	152.8	4.8	6.4	75	2.2	28.5	14.5	62.9	−44.6	44.8	44.1
10–Apr	3	0	46.0	6.2	39.80	154.3	4.8	6.4	75	2.2			ERR		ERR	ERR
10–Apr	3	1	0.0	0.0	0.00	154.4	4.8	6.4	75	ERR			ERR		ERR	ERR
10–Apr	3	11	0.0	0.0	0.00	154.5	4.8	6.4	75	ERR	28.8	14.7	62.7	−40.0	48.0	40.3
10–Apr	3	12	46.0	6.2	39.80	154.5	4.8	6.4	75	2.2			ERR		ERR	ERR
10–Apr	5	0	46.0	6.0	40.00	156.3	4.9	6.5	76	2.1			ERR		ERR	ERR
10–Apr	10	5	49.5	6.5	43.00	161.4	5.2	6.7	77	2.1	28.3	15.0	60.3	−42.1	44.8	40.5
10–Apr	11	39	49.5	6.5	43.00	163.0	5.2	6.8	77	2.1			ERR		ERR	ERR
10–Apr	11	40	0.0	0.0	0.00	163.0	5.2	6.8	77	ERR			ERR		ERR	ERR
10–Apr	11	54	0.0	0.0	0.00	163.2	5.2	6.8	77	ERR			ERR		ERR	ERR
10–Apr	11	55	49.0	6.5	42.50	163.3	5.2	6.8	77	2.1	28.4	14.0	64.9	−42.4	47.9	43.7
10–Apr	14	20	48.0	6.5	41.50	165.7	5.3	6.9	77	2.2	28.3	14.7	61.6	−42.0	45.8	41.2
10–Apr	15	38	48.0	6.5	41.50	167.0	5.4	7.0	78	2.2			ERR		ERR	ERR
10–Apr	15	39	0.0	0.0	0.00	167.0	5.4	7.0	78	ERR			ERR		ERR	ERR
10–Apr	15	44	0.0	0.0	0.00	167.1	5.4	7.0	78	ERR			ERR		ERR	ERR
10–Apr	15	45	48.0	6.5	41.50	167.1	5.4	7.0	78	2.2			ERR		ERR	ERR
10–Apr	17	36	47.0	6.5	40.50	168.9	5.5	7.0	78	2.2	28.0	14.5	61.8	−42.1	45.8	41.4

Table C-1 Operating Data -- Electrical (Continued)

DATE	TIME hr	TIME mi	Power at Array in kW Forw.	Power at Array in kW Refl.	Input Power in kW	Elapsed Time hours	Equiv. Days at 40 kW	Elapsed Days	Source Utilization %	VSWR	Vector Voltmeter Va mV	Vector Voltmeter Vb mV	Z ohm	Angle degree	Z Real	Z Imaginary
10–Apr	19	23	47.0	6.2	40.80	170.7	5.6	7.1	78	2.1	28.6	14.4	63.5	−44.4	45.4	44.4
10–Apr	20	32	46.5	6.2	40.30	171.9	5.6	7.2	78	2.2			ERR		ERR	ERR
10–Apr	20	33	0.0	0.0	0.00	171.9	5.6	7.2	78	ERR			ERR		ERR	ERR
10–Apr	20	37	0.0	0.0	0.00	172.0	5.6	7.2	78	ERR			ERR		ERR	ERR
10–Apr	20	38	46.5	6.2	40.30	172.0	5.6	7.2	78	2.2			ERR		ERR	ERR
10–Apr	22	13	46.5	6.2	40.30	173.6	5.7	7.2	78	2.2	29.0	14.3	64.9	−42.6	47.7	43.9
11–Apr	0	0	47.0	6.2	40.80	175.3	5.7	7.3	79	2.1	29.1	14.3	65.1	−41.6	48.7	43.2
11–Apr	0	9	46.0	5.9	40.10	175.5	5.8	7.3	79	2.1			ERR		ERR	ERR
11–Apr	0	10	0.0	0.0	0.00	175.5	5.8	7.3	79	ERR			ERR		ERR	ERR
11–Apr	0	14	0.0	0.0	0.00	175.6	5.8	7.3	79	ERR			ERR		ERR	ERR
11–Apr	0	15	46.0	5.9	40.10	175.6	5.8	7.3	79	2.1			ERR		ERR	ERR
11–Apr	2	0	47.0	5.8	41.20	177.3	5.8	7.4	78	2.1	29.4	14.4	65.3	−41.7	48.7	43.4
11–Apr	3	0	48.0	5.8	42.20	178.3	5.8	7.4	79	2.1	29.5	14.4	65.5	−42.5	48.3	44.3
11–Apr	4	0	48.0	6.0	42.00	179.3	5.9	7.5	79	2.1	29.6	14.4	65.7	−43.5	47.7	45.3
11–Apr	5	0	48.0	6.2	41.80	180.3	5.9	7.5	79	2.1	29.6	14.3	66.2	−43.4	48.1	45.5
11–Apr	5	54	48.0	6.2	41.80	181.2	6.0	7.6	79	2.1			ERR		ERR	ERR
11–Apr	5	55	0.0	0.0	0.00	181.3	6.0	7.6	79	ERR			ERR		ERR	ERR
11–Apr	5	59	0.0	0.0	0.00	181.3	6.0	7.6	79	ERR			ERR		ERR	ERR
11–Apr	6	0	48.0	6.2	41.80	181.3	6.0	7.6	79	2.1	29.8	14.4	66.2	−43.2	48.2	45.3
11–Apr	9	53	48.0	6.2	41.80	185.2	6.1	7.7	79	2.1	29.7	13.7	69.3	−41.6	51.8	46.0
11–Apr	11	30	49.0	6.5	42.50	186.8	6.2	7.8	80	2.1	29.3	13.5	69.4	−41.4	52.1	45.9
11–Apr	12	36	49.0	6.5	42.50	187.9	6.3	7.8	80	2.1			ERR		ERR	ERR
11–Apr	12	37	0.0	0.0	0.00	188.0	6.3	7.8	80	ERR			ERR		ERR	ERR
11–Apr	16	13	0.0	0.0	0.00	191.6	6.3	8.0	78	ERR			ERR		ERR	ERR
11–Apr	16	14	47.8	6.0	41.80	191.6	6.3	8.0	78	2.1			ERR		ERR	ERR
11–Apr	16	39	47.8	6.0	41.80	192.0	6.3	8.0	78	2.1	28.3	13.3	68.0	−41.7	50.8	45.3
11–Apr	19	43	47.8	6.0	41.80	195.1	6.4	8.1	79	2.1			ERR		ERR	ERR
11–Apr	19	44	0.0	0.0	0.00	195.1	6.4	8.1	79	ERR			ERR		ERR	ERR

Table C-1 Operating Data -- Electrical (Continued)

DATE	TIME hr	TIME mi	Power at Array in kW Forw.	Power at Array in kW Refl.	Input Power in kW	Elapsed Time hours	Equiv. Days at 40 kW	Elapsed Days	Source Utilization %	VSWR	Vector Voltmeter Va mV	Vector Voltmeter Vb mV	Z ohm	Angle degree	Z Real	Z Imaginary
11-Apr	19	33	47.5	6.1	41.40	194.9	6.4	8.1	79	2.1			ERR		ERR	ERR
11-Apr	21	59	47.5	6.1	41.40	197.3	6.5	8.2	79	2.1			ERR		ERR	ERR
11-Apr	22	0	0.0	0.0	0.00	197.3	6.5	8.2	79	ERR			ERR		ERR	ERR
11-Apr	22	10	0.0	0.0	0.00	197.5	6.5	8.2	78	ERR			ERR		ERR	ERR
11-Apr	22	11	47.5	6.1	41.40	197.5	6.5	8.2	78	2.1			ERR		ERR	ERR
11-Apr	22	20	47.5	6.1	41.40	197.7	6.5	8.2	78	2.1			ERR		ERR	ERR
11-Apr	22	11	0.0	0.0	0.00	197.5	6.5	8.2	78	ERR			ERR		ERR	ERR
11-Apr	22	43	0.0	0.0	0.00	198.1	6.5	8.3	78	ERR			ERR		ERR	ERR
11-Apr	22	44	47.8	6.0	41.80	198.1	6.5	8.3	78	2.1			ERR		ERR	ERR
11-Apr	23	10	47.8	6.0	41.80	198.5	6.5	8.3	78	2.1	29.6	13.2	71.7	-40.8	54.3	46.9
12-Apr	0	30	47.8	6.0	41.80	199.8	6.5	8.3	79	2.1	29.7	13.3	13.3	-41.4	10.0	8.8
12-Apr	1	40	48.0	6.2	41.80	201.0	6.6	8.4	79	2.1	29.7	13.4	70.9	-41.9	52.8	47.3
12-Apr	3	0	48.0	6.2	41.80	202.3	6.6	8.4	79	2.1	29.7	13.3	71.4	-42.2	52.9	48.0
12-Apr	4	0	48.0	6.2	41.80	203.3	6.7	8.5	79	2.1	29.7	13.2	72.0	-42.1	53.4	48.2
12-Apr	4	19	48.0	6.2	41.80	203.7	6.7	8.5	79	2.1			ERR		ERR	ERR
12-Apr	4	20	0.0	0.0	0.00	203.7	6.7	8.5	79	ERR			ERR		ERR	ERR
12-Apr	4	27	0.0	0.0	0.00	203.8	6.7	8.5	79	ERR			ERR		ERR	ERR
12-Apr	4	28	48.0	6.2	41.80	203.8	6.7	8.5	79	2.1			ERR		ERR	ERR
12-Apr	5	0	48.0	6.2	41.80	204.3	6.7	8.5	79	2.1	30.0	13.3	72.1	-41.1	54.4	47.4
12-Apr	6	0	48.0	6.2	41.80	205.3	6.8	8.6	79	2.1	29.9	13.1	73.0	-41.0	55.1	47.9
12-Apr	7	0	46.0	6.0	40.00	206.3	6.8	8.6	79	2.1	29.5	13.0	72.6	-42.2	53.8	48.7
12-Apr	8	0	48.0	6.2	41.80	207.3	6.9	8.6	79	2.1	29.8	13.2	72.2	-42.0	53.7	48.3
12-Apr	9	25	48.0	6.2	41.80	208.8	6.9	8.7	80	2.1	30.0	12.9	74.4	-40.9	56.2	48.7
12-Apr	9	32	48.0	6.2	41.80	208.9	6.9	8.7	80	2.1			ERR		ERR	ERR
12-Apr	9	33	0.0	0.0	0.00	208.9	6.9	8.7	80	ERR			ERR		ERR	ERR
12-Apr	10	29	0.0	0.0	0.00	209.8	6.9	8.7	79	ERR	30.0	13.1	73.2	-40.2	55.9	47.3
12-Apr	10	30	48.0	6.2	41.80	209.8	6.9	8.7	79	2.1			ERR		ERR	ERR
12-Apr	13	14	47.5	6.0	41.50	212.6	7.0	8.9	80	2.1			ERR		ERR	ERR

Table C-1 Operating Data -- Electrical (Continued)

DATE	TIME hr	TIME mi	Power at Array in kW Forw.	Power at Array in kW Refl.	Input Power in kW	Elapsed Time hours	Equiv. Days at 40 kW	Elapsed Days	Source Utilization %	VSWR	Vector Voltmeter Va mV	Vector Voltmeter Vb mV	Z ohm	Angle degree	Z Real	Z Imaginary
12-Apr	13	15	0.0	0.0	0.00	212.6	7.0	8.9	80	ERR			ERR		ERR	ERR
12-Apr	13	27	0.0	0.0	0.00	212.8	7.0	8.9	79	ERR			ERR		ERR	ERR
12-Apr	13	28	47.5	6.0	41.50	212.8	7.0	8.9	79	2.1	29.3	13.0	72.1	−39.0	56.0	45.4
12-Apr	15	47	47.5	6.2	41.30	215.1	7.1	9.0	80	2.1	29.1	12.9	72.1	−39.5	55.7	45.9
12-Apr	18	10	46.5	6.2	40.30	217.5	7.2	9.1	80	2.2	29.5	12.8	73.7	−39.6	56.8	47.0
12-Apr	19	42	46.0	6.0	40.00	219.0	7.3	9.1	80	2.1			ERR		ERR	ERR
12-Apr	19	43	0.0	0.0	0.00	219.1	7.3	9.1	80	ERR			ERR		ERR	ERR
12-Apr	19	46	0.0	0.0	0.00	219.1	7.3	9.1	80	ERR			ERR		ERR	ERR
12-Apr	19	47	47.0	6.2	40.80	219.1	7.3	9.1	80	2.1			ERR		ERR	ERR
12-Apr	22	0	47.0	6.2	40.80	221.3	7.4	9.2	80	2.1	30.2	12.8	75.5	−40.0	57.8	48.5
12-Apr	23	47	48.0	6.5	41.50	223.1	7.5	9.3	80	2.2	30.5	12.8	76.2	−39.8	58.5	48.8
13-Apr	2	0	48.0	6.2	41.80	225.3	7.6	9.4	81	2.1	30.5	12.8	76.2	−39.9	58.5	48.9
13-Apr	4	0	48.0	6.2	41.80	227.3	7.7	9.5	81	2.1	30.5	12.7	76.8	−39.8	59.0	49.2
13-Apr	5	59	48.0	6.2	41.80	229.3	7.7	9.6	81	2.1			ERR		ERR	ERR
13-Apr	6	0	0.0	0.0	0.00	229.3	7.6	9.6	79	ERR			ERR		ERR	ERR
13-Apr	6	5	0.0	0.0	0.00	229.4	7.6	9.6	80	ERR			ERR		ERR	ERR
13-Apr	6	6	48.0	6.2	41.80	229.4	7.8	9.6	81	2.1			ERR		ERR	ERR
13-Apr	6	10	48.0	6.2	41.80	229.5	7.8	9.6	81	2.1	30.5	12.7	76.8	−39.5	59.3	48.9
13-Apr	14	4	48.0	6.5	41.50	237.4	8.1	9.9	82	2.2	30.0	12.2	78.6	−39.6	60.6	50.1
13-Apr	14	5	0.0	0.0	0.00	237.4	8.1	9.9	82	ERR			ERR		ERR	ERR
13-Apr	14	11	0.0	0.0	0.00	237.5	8.1	9.9	82	ERR			ERR		ERR	ERR
13-Apr	14	12	48.0	6.5	41.50	237.5	8.1	9.9	82	2.2			ERR		ERR	ERR
13-Apr	16	2	47.0	6.5	40.50	239.4	8.2	10.0	82	2.2	30.5	12.3	79.3	−38.4	62.1	49.3
13-Apr	20	52	46.5	6.5	40.00	244.2	8.4	10.2	82	2.2	30.5	12.1	80.6	−38.4	63.2	50.1
13-Apr	20	53	0.0	0.0	0.00	244.2	8.4	10.2	82	ERR			ERR		ERR	ERR
13-Apr	20	57	0.0	0.0	0.00	244.3	8.4	10.2	82	ERR			ERR		ERR	ERR
13-Apr	20	58	46.5	6.5	40.00	244.3	8.4	10.2	82	2.2			ERR		ERR	ERR
14-Apr	0	0	46.5	6.5	40.00	247.3	8.4	10.3	82	2.2	30.8	12.0	82.1	−38.3	64.4	50.9

Table C-1 Operating Data -- Electrical (Continued)

DATE	TIME hr	TIME mi	Power at Array in kW Forw.	Power at Array in kW Refl.	Input Power in kW	Elapsed Time hours	Equiv. Days at 40 kW	Elapsed Days	Source Utilization %	VSWR	Vector Voltmeter Va mV	Vector Voltmeter Vb mV	Z ohm	Angle degree	Z Real	Z Imaginary
14-Apr	2	0	46.5	6.5	40.00	249.3	8.6	10.4	83	2.2	31.0	12.0	82.6	-38.2	64.9	51.1
14-Apr	2	1	0.0	0.0	0.00	249.4	8.5	10.4	82	ERR			ERR		ERR	ERR
14-Apr	2	8	0.0	0.0	0.00	249.5	8.6	10.4	83	ERR			ERR		ERR	ERR
14-Apr	2	9	46.5	6.5	40.00	249.5	8.5	10.4	82	2.2			ERR		ERR	ERR
14-Apr	4	59	46.5	6.5	40.00	252.3	8.7	10.5	82	2.2			ERR		ERR	ERR
14-Apr	5	0	0.0	0.0	0.00	252.3	8.5	10.5	81	ERR			ERR		ERR	ERR
14-Apr	5	6	0.0	0.0	0.00	252.4	8.7	10.5	82	ERR			ERR		ERR	ERR
14-Apr	5	7	46.5	6.5	40.00	252.5	8.6	10.5	81	2.2	30.9	12.0	82.3	-37.4	65.4	50.0
14-Apr	9	49	47.0	6.3	40.70	257.2	8.8	10.7	82	2.2			ERR		ERR	ERR
14-Apr	9	50	0.0	0.0	0.00	257.2	8.7	10.7	81	ERR			ERR		ERR	ERR
14-Apr	9	57	0.0	0.0	0.00	257.3	8.8	10.7	82	ERR			ERR		ERR	ERR
14-Apr	9	58	47.0	6.3	40.70	257.3	8.7	10.7	81	2.2			ERR		ERR	ERR
14-Apr	19	20	47.0	6.3	40.70	266.7	9.0	11.1	81	2.2			ERR		ERR	ERR
14-Apr	19	21	0.0	0.0	0.00	266.7	8.9	11.1	80	ERR			ERR		ERR	ERR
14-Apr	19	25	0.0	0.0	0.00	266.8	9.0	11.1	81	ERR			ERR		ERR	ERR
14-Apr	19	26	47.0	6.3	40.70	266.8	8.9	11.1	80	2.2			ERR		ERR	ERR
15-Apr	0	0	48.0	7.0	41.00	271.3	9.1	11.3	80	2.2	32.2	12.0	85.8	-35.6	69.8	50.0
15-Apr	3	59	48.0	7.0	41.00	275.3	9.4	11.5	82	2.2			ERR		ERR	ERR
15-Apr	4	0	0.0	0.0	0.00	275.3	9.1	11.5	80	ERR	32.1	12.0	85.5	-35.4	69.7	49.6
15-Apr	4	4	0.0	0.0	0.00	275.4	9.4	11.5	82	ERR			ERR		ERR	ERR
15-Apr	4	5	48.0	7.0	41.00	275.4	9.1	11.5	80	2.2			ERR		ERR	ERR
15-Apr	10	15	52.0	7.3	44.70	281.6	9.6	11.7	82	2.2	32.0	11.5	89.0	-36.3	71.7	52.7
15-Apr	11	2	52.0	7.3	44.70	282.4	9.5	11.8	80	2.2			ERR		ERR	ERR
15-Apr	11	3	0.0	0.0	0.00	282.4	9.6	11.8	81	ERR			ERR		ERR	ERR
15-Apr	11	10	0.0	0.0	0.00	282.5	9.5	11.8	80	ERR			ERR		ERR	ERR
15-Apr	11	11	50.0	7.3	42.70	282.5	9.6	11.8	81	2.2	32.0	11.4	89.8	-35.6	73.0	52.3
15-Apr	20	18	49.0	7.4	41.60	291.6	9.7	12.2	79	2.3	32.1	11.2	91.7	-34.9	75.2	52.4
15-Apr	20	19	0.0	0.0	0.00	291.7	9.8	12.2	81	ERR			ERR		ERR	ERR

Table C-1 Operating Data -- Electrical (Continued)

DATE	TIME hr	TIME mi	Power at Array in kW Forw.	Power at Array in kW Refl.	Input Power in kW	Elapsed Time hours	Equiv. Days at 40 kW	Elapsed Days	Source Utilization %	VSWR	Vector Voltmeter Va mV	Vector Voltmeter Vb mV	Z ohm	Angle degree	Z Real	Z Imaginary
15-Apr	20	22	0.0	0.0	0.00	291.7	9.7	12.2	79	ERR			ERR		ERR	ERR
15-Apr	20	23	49.0	7.4	41.60	291.7	9.8	12.2	81	2.3			ERR		ERR	ERR
15-Apr	21	40	49.0	7.4	41.60	293.0	9.7	12.2	79	2.3	32.5	11.3	92.0	-34.7	75.6	52.4
16-Apr	0	0	48.0	7.5	40.50	295.3	9.9	12.3	81	2.3	33.0	11.7	90.2	-34.7	74.2	51.3
16-Apr	2	0	48.5	7.5	41.00	297.3	9.9	12.4	80	2.3	33.2	11.7	90.7	-34.6	74.7	51.5
16-Apr	4	0	48.0	7.5	40.50	299.3	10.1	12.5	81	2.3	33.2	11.7	90.7	-34.2	75.1	51.0
16-Apr	6	0	50.0	7.5	42.50	301.3	10.1	12.6	80	2.3	33.3	11.7	91.0	-34.3	75.2	51.3
16-Apr	7	10	49.5	7.6	41.90	302.5	10.3	12.6	81	2.3	33.8	11.5	94.0	-34.0	77.9	52.6
16-Apr	10	0	51.5	7.9	43.60	305.3	10.2	12.7	80	2.3			ERR		ERR	ERR
16-Apr	13	3	0.0	0.0	0.00	308.4	10.4	12.8	81	ERR			ERR		ERR	ERR
16-Apr	13	14	0.0	0.0	0.00	308.6	10.3	12.9	80	ERR			ERR		ERR	ERR
16-Apr	13	15	50.0	8.0	42.00	308.6	10.4	12.9	81	2.3	33.0	11.0	95.9	-34.0	79.5	53.6
16-Apr	19	4	0.0	0.0	0.00	314.4	10.3	13.1	79	ERR			ERR		ERR	ERR
16-Apr	19	13	0.0	0.0	0.00	314.6	10.5	13.1	80	ERR			ERR		ERR	ERR
16-Apr	19	14	51.0	8.1	42.90	314.6	10.3	13.1	79	2.3	33.9	11.2	96.8	-34.7	79.6	55.1
16-Apr	21	35	50.0	8.0	42.00	316.9	10.6	13.2	80	2.3	34.0	11.0	98.8	-34.8	81.2	56.4
16-Apr	23	2	0.0	0.0	0.00	318.4	10.4	13.3	78	ERR			ERR		ERR	ERR
17-Apr	0	14	0.0	0.0	0.00	319.6	10.6	13.3	80	ERR			ERR		ERR	ERR
17-Apr	0	15	50.0	8.5	41.50	319.6	10.4	13.3	78	2.4			ERR		ERR	ERR
17-Apr	2	0	50.0	8.5	41.50	321.3	10.7	13.4	80	2.4	33.2	11.7	90.7	-34.6	74.7	51.5
17-Apr	8	20	52.0	8.8	43.20	327.7	10.8	13.7	79	2.4			ERR		ERR	ERR
17-Apr	14	20	52.5	9.0	43.50	333.7	11.2	13.9	81	2.4			ERR		ERR	ERR
17-Apr	16	5	52.0	9.0	43.00	335.4	11.1	14.0	80	2.4			ERR		ERR	ERR
17-Apr	17	4	52.0	9.0	43.00	336.4	11.3	14.0	81	2.4			ERR		ERR	ERR
17-Apr	17	5	0.0	0.0	0.00	336.4	11.1	14.0	80	ERR			ERR		ERR	ERR
17-Apr	21	39	0.0	0.0	0.00	341.0	11.4	14.2	80	ERR			ERR		ERR	ERR
17-Apr	21	40	52.0	9.0	43.00	341.0	11.2	14.2	79	2.4	35.0	11.1	100.8	-31.2	86.3	52.2
18-Apr	0	5	52.0	9.0	43.00	343.4	11.5	14.3	80	2.4	35.0	11.0	101.8	-31.2	87.0	52.7

Table C-1 Operating Data -- Electrical (Continued)

DATE	TIME hr	TIME mi	Power at Array in kW Forw.	Power at Array in kW Refl.	Input Power in kW	Elapsed Time hours	Equiv. Days at 40 kW	Elapsed Days	Source Utilization %	VSWR	Vector Voltmeter Va mV	Vector Voltmeter Vb mV	Z ohm	Angle degree	Z Real	Z Imaginary
18-Apr	0	6	0.0	0.0	0.00	343.4	11.3	14.3	79	ERR			ERR		ERR	ERR
18-Apr	1	38	0.0	0.0	0.00	345.0	11.5	14.4	80	ERR			ERR		ERR	ERR
18-Apr	1	39	52.0	9.0	43.00	345.0	11.3	14.4	79	2.4	35.0	11.0	101.8	-31.2	87.0	52.7
18-Apr	10	10	52.5	9.5	43.00	353.5	11.7	14.7	80	2.5	35.0	11.1	100.8	-31.7	85.8	53.0
18-Apr	12	25	54.0	9.9	44.10	355.8	11.8	14.8	80	2.5	34.6	11.2	98.8	-32.0	83.8	52.4
18-Apr	20	1	53.0	10.0	43.00	363.4	12.2	15.1	80	2.5	35.5	11.0	103.2	-33.2	86.4	56.5
18-Apr	22	36	52.0	10.0	42.00	365.9	12.3	15.2	81	2.6	36.0	11.0	-33.2		-33.2	0.0
19-Apr	1	20	52.0	10.0	42.00	368.7	12.4	15.4	81	2.6	36.0	11.0	104.7	-33.4	87.4	57.6
19-Apr	6	30	54.0	10.0	44.00	373.8	12.6	15.6	81	2.5	36.0	11.0	104.7	-33.0	87.8	57.0
19-Apr	13	15	56.0	11.0	45.00	380.6	12.9	15.9	82	2.6	35.9	10.4	110.4	-34.8	90.6	63.0
19-Apr	13	16	0.0	0.0	0.00	380.6	12.8	15.9	81	ERR			ERR		ERR	ERR
19-Apr	14	34	0.0	0.0	0.00	381.9	13.0	15.9	81	ERR			ERR		ERR	ERR
19-Apr	14	35	54.0	11.0	43.00	381.9	12.8	15.9	81	2.6			ERR		ERR	ERR
19-Apr	18	23	55.0	11.0	44.00	385.7	13.0	16.1	81	2.6	35.5	10.4	109.2	-34.8	89.6	62.3
19-Apr	19	13	55.0	11.0	44.00	386.6	13.0	16.1	81	2.6			ERR		ERR	ERR
19-Apr	19	14	0.0	0.0	0.00	386.6	13.1	16.1	81	ERR			ERR		ERR	ERR
19-Apr	19	25	0.0	0.0	0.00	386.8	13.0	16.1	81	ERR			ERR		ERR	ERR
19-Apr	19	26	55.0	11.2	43.80	386.8	13.1	16.1	81	2.6	36.1	10.4	111.0	-35.1	90.8	63.8
19-Apr	22	27	54.0	11.2	42.80	389.8	13.1	16.2	81	2.7	37.1	10.4	114.1	-35.5	92.9	66.2
20-Apr	8	30	56.0	12.0	44.00	399.8	13.7	16.7	82	2.7	37.5	10.0	119.9	-37.5	95.1	73.0
20-Apr	13	34	57.0	12.3	44.70	404.9	13.8	16.9	82	2.7			ERR		ERR	ERR
20-Apr	13	35	0.0	0.0	0.00	404.9	13.8	16.9	82	ERR			ERR		ERR	ERR
20-Apr	13	44	0.0	0.0	0.00	405.1	13.8	16.9	82	ERR			ERR		ERR	ERR
20-Apr	13	45	57.0	12.5	44.50	405.1	13.8	16.9	82	2.8	37.9	11.1	109.2	-35.6	88.8	63.6
20-Apr	19	50	56.0	12.8	43.20	411.2	13.9	17.1	81	2.8	38.3	11.0	111.3	-32.0	94.4	59.0
20-Apr	19	51	0.0	0.0	0.00	411.2	13.9	17.1	81	ERR			ERR		ERR	ERR
20-Apr	20	29	0.0	0.0	0.00	411.8	13.9	17.2	81	ERR			ERR		ERR	ERR
20-Apr	20	30	57.0	13.0	44.00	411.8	13.9	17.2	81	2.8	38.5	11.0	111.9	-31.9	95.0	59.1

Table C-1 Operating Data -- Electrical (Continued)

DATE	TIME hr	TIME mi	Power at Array in kW Forw.	Power at Array in kW Refl.	Input Power in kW	Elapsed Time hours	Equiv. Days at 40 kW	Elapsed Days	Source Utilization %	VSWR	Vector Voltmeter Va mV	Vector Voltmeter Vb mV	Z ohm	Angle degree	Z Real	Z Imaginary
20-Apr	21	39	57.0	13.0	44.00	413.0	14.0	17.2	81	2.8			ERR		ERR	ERR
20-Apr	21	40	0.0	0.0	0.00	413.0	14.0	17.2	81	ERR			ERR		ERR	ERR
21-Apr	0	54	0.0	0.0	0.00	416.2	14.0	17.3	81	ERR			ERR		ERR	ERR
21-Apr	0	55	58.0	13.0	45.00	416.3	14.1	17.3	81	2.8	39.1	10.0	125.0	-32.7	105.2	67.6
21-Apr	6	0	58.6	13.0	45.60	421.3	14.2	17.6	81	2.8	39.0	11.0	113.4	-38.1	89.2	70.0
21-Apr	11	19	58.0	13.0	45.00	426.7	14.5	17.8	82	2.8			ERR		ERR	ERR
21-Apr	11	20	0.0	0.0	0.00	426.7	14.3	17.8	80	ERR			ERR		ERR	ERR
21-Apr	16	29	0.0	0.0	0.00	431.8	14.7	18.0	81	ERR			ERR		ERR	ERR
21-Apr	16	30	56.0	13.0	43.00	431.8	14.4	18.0	80	2.9	38.1	9.7	125.6	-38.5	98.3	78.2
21-Apr	19	43	57.5	13.5	44.00	435.1	14.7	18.1	81	2.9	39.0	9.9	126.0	-38.8	98.2	78.9
21-Apr	19	59	57.5	13.5	44.00	435.3	14.6	18.1	80	2.9			ERR		ERR	ERR
21-Apr	20	0	0.0	0.0	0.00	435.3	14.7	18.1	81	ERR			ERR		ERR	ERR
21-Apr	23	59	0.0	0.0	0.00	439.3	14.7	18.3	80	ERR			ERR		ERR	ERR
21-Apr	0	0	60.0	14.0	46.00	415.3	14.3	17.3	82	2.9	40.0	10.0	127.9	-38.5	100.1	79.6
22-Apr	9	15	56.0	13.5	42.50	448.6	14.9	18.7	80	2.9	38.0	9.6	126.6	-40.7	96.0	82.5
22-Apr	10	40	55.0	13.4	41.60	450.0	15.8	18.8	84	2.9	37.5	9.4	127.6	-41.0	96.3	83.7
22-Apr	13	27	55.0	13.4	41.60	452.8	15.1	18.9	80	2.9			ERR		ERR	ERR
22-Apr	13	28	0.0	0.0	0.00	452.8	15.9	18.9	84	ERR			ERR		ERR	ERR
22-Apr	18	9	0.0	0.0	0.00	457.5	15.2	19.1	79	ERR			ERR		ERR	ERR
22-Apr	18	10	60.0	15.0	45.00	457.5	16.0	19.1	84	3.0	39.5	9.7	130.2	-40.8	98.6	85.1
23-Apr	1	30	60.0	15.0	45.00	464.8	15.3	19.4	79	3.0	41.0	10.0	131.1	-41.6	98.0	87.1
23-Apr	9	40	65.0	16.6	48.40	473.0	16.8	19.7	85	3.0	40.0	10.0	127.9	-42.7	94.0	86.8
23-Apr	12	19	65.0	16.6	48.40	475.7	15.9	19.8	80	3.0			ERR		ERR	ERR
23-Apr	12	20	0.0	0.0	0.00	475.7	16.8	19.8	85	ERR			ERR		ERR	ERR
23-Apr	13	19	0.0	0.0	0.00	476.7	15.9	19.9	80	ERR			ERR		ERR	ERR
23-Apr	13	20	61.0	16.0	45.00	476.7	16.9	19.9	85	3.1	39.5	9.6	131.6	-44.6	93.7	92.4
24-Apr	0	10	64.0	17.5	46.50	487.5	16.1	20.3	79	3.2	41.9	10.0	134.0	-44.0	96.4	93.1
24-Apr	0	59	64.0	17.5	46.50	488.3	17.4	20.3	86	3.2			ERR		ERR	ERR

Table C-1 Operating Data -- Electrical (Continued)

DATE	TIME hr	TIME mi	Power at Array in kW Forw.	Power at Array in kW Refl.	Input Power in kW	Elapsed Time hours	Equiv. Days at 40 kW	Elapsed Days	Source Utilization %	VSWR	Vector Voltmeter Va mV	Vector Voltmeter Vb mV	Z ohm	Angle degree	Z Real	Z Imaginary
24-Apr	1	0	0.0	0.0	0.00	488.3	16.2	20.3	79	ERR			ERR		ERR	ERR
24-Apr	1	54	0.0	0.0	0.00	489.2	17.4	20.4	86	ERR			ERR		ERR	ERR
24-Apr	1	55	64.0	17.5	46.50	489.3	16.2	20.4	79	3.2			ERR		ERR	ERR
24-Apr	13	4	64.0	17.9	46.10	500.4	17.7	20.9	85	3.2			ERR		ERR	ERR
24-Apr	13	5	0.0	0.0	0.00	500.4	16.5	20.9	79	ERR			ERR		ERR	ERR
24-Apr	13	29	0.0	0.0	0.00	500.8	17.7	20.9	85	ERR			ERR		ERR	ERR
24-Apr	13	30	66.0	18.5	47.50	500.8	16.5	20.9	79	3.3	41.2	9.8	134.4	−46.1	93.2	96.9
24-Apr	22	34	64.0	18.2	45.80	509.9	17.9	21.2	84	3.3	42.0	9.8	137.1	−47.2	93.1	100.6
25-Apr	2	39	64.0	18.5	45.50	514.0	17.1	21.4	80	3.3			ERR		ERR	ERR
25-Apr	2	40	0.0	0.0	0.00	514.0	18.0	21.4	84	ERR			ERR		ERR	ERR
25-Apr	2	49	0.0	0.0	0.00	514.2	17.1	21.4	80	ERR			ERR		ERR	ERR
25-Apr	2	50	62.0	18.5	43.50	514.2	18.0	21.4	84	3.4			ERR		ERR	ERR
25-Apr	9	34	64.0	19.0	45.00	520.9	17.3	21.7	80	3.4	41.8	9.9	135.0	−47.5	91.2	99.6
25-Apr	9	35	0.0	0.0	0.00	520.9	18.2	21.7	84	ERR			ERR		ERR	ERR
25-Apr	11	54	0.0	0.0	0.00	523.2	17.3	21.8	79	ERR			ERR		ERR	ERR
25-Apr	11	55	65.0	19.1	45.90	523.3	18.2	21.8	84	3.4	41.9	10.0	134.0	−47.5	90.5	98.8
25-Apr	20	44	65.0	19.2	45.80	532.1	17.5	22.2	79	3.4	41.0	10.0	131.1	−48.5	86.9	98.2
25-Apr	20	45	0.0	0.0	0.00	532.1	18.5	22.2	83	ERR			ERR		ERR	ERR
25-Apr	21	33	0.0	0.0	0.00	532.9	17.5	22.2	79	ERR			ERR		ERR	ERR
25-Apr	21	34	65.0	19.2	45.80	532.9	18.5	22.2	83	3.4			ERR		ERR	ERR
26-Apr	0	9	66.0	20.0	46.00	535.5	17.6	22.3	79	3.4			ERR		ERR	ERR
26-Apr	0	10	0.0	0.0	0.00	535.5	18.5	22.3	83	ERR			ERR		ERR	ERR
26-Apr	1	29	0.0	0.0	0.00	536.8	17.6	22.4	79	ERR			ERR		ERR	ERR
26-Apr	1	30	66.0	20.0	46.00	536.8	18.6	22.4	83	3.4			ERR		ERR	ERR
26-Apr	12	55	69.0	21.0	48.00	548.3	17.9	22.8	78	3.5	43.5	14.1	98.7	−39.5	76.1	62.8
26-Apr	14	11	69.0	21.0	48.00	549.5	19.2	22.9	84	3.5			ERR		ERR	ERR
26-Apr	14	12	0.0	0.0	0.00	549.5	18.0	22.9	78	ERR			ERR		ERR	ERR
26-Apr	14	21	0.0	0.0	0.00	549.7	19.2	22.9	84	ERR			ERR		ERR	ERR

Table C-1 Operating Data -- Electrical (Continued)

DATE	TIME hr	TIME mi	Power at Array in kW Forw.	Power at Array in kW Refl.	Input Power in kW	Elapsed Time hours	Equiv. Days at 40 kW	Elapsed Days	Source Utilization %	VSWR	Vector Voltmeter Va mV	Vector Voltmeter Vb mV	Z ohm	Angle degree	Z Real	Z Imaginary
26-Apr	14	22	67.0	21.0	46.00	549.7	18.0	22.9	78	3.5	42.5	14.2	95.7	-39.0	74.4	60.2
26-Apr	20	0	67.0	21.0	46.00	555.3	19.3	23.1	84	3.5	42.8	13.7	99.9	-40.4	76.1	64.8
26-Apr	20	1	0.0	0.0	0.00	555.4	18.1	23.1	78	ERR			ERR		ERR	ERR
26-Apr	21	4	0.0	0.0	0.00	556.4	19.4	23.2	83	ERR			ERR		ERR	ERR
26-Apr	21	5	67.0	21.0	46.00	556.4	18.1	23.2	78	3.5			ERR		ERR	ERR
26-Apr	21	45	68.0	22.0	46.00	557.1	19.4	23.2	83	3.6	42.8	13.5	101.4	-42.0	75.3	67.8
27-Apr	3	0	67.0	22.0	45.00	562.3	18.4	23.4	79	3.7	44.0	14.0	100.5	-42.6	74.0	68.0
27-Apr	12	30	70.0	23.6	46.40	571.8	20.1	23.8	84	3.8	45.5	10.5	138.6	-53.5	82.4	111.4
27-Apr	14	29	70.0	23.6	46.40	573.8	18.9	23.9	79	3.8			ERR		ERR	ERR
27-Apr	14	30	0.0	0.0	0.00	573.8	20.1	23.9	84	ERR			ERR		ERR	ERR
27-Apr	14	39	0.0	0.0	0.00	574.0	19.0	23.9	79	ERR			ERR		ERR	ERR
27-Apr	14	40	70.0	29.0	41.00	574.0	20.1	23.9	84	4.6	45.1	10.5	137.4	-53.6	81.5	110.6
27-Apr	20	25	70.0	29.0	41.00	579.8	19.1	24.2	79	4.6	45.0	10.5	137.1	-54.2	80.2	111.2
28-Apr	6	35	72.0	29.5	42.50	589.9	20.8	24.6	85	4.6	45.6	10.5	138.9	-55.0	79.7	113.8
28-Apr	11	4	72.0	29.5	42.50	594.4	19.7	24.8	80	4.6			ERR		ERR	ERR
28-Apr	11	5	0.0	0.0	0.00	594.4	20.9	24.8	84	ERR			ERR		ERR	ERR
28-Apr	11	54	0.0	0.0	0.00	595.2	19.7	24.8	80	ERR			ERR		ERR	ERR
28-Apr	11	55	72.0	29.5	42.50	595.3	20.9	24.8	84	4.6			ERR		ERR	ERR
28-Apr	22	35	76.0	32.0	44.00	605.9	20.0	25.2	79	4.7	46.3	10.9	135.8	-56.7	74.6	113.5
29-Apr	1	0	75.0	32.5	42.50	608.3	21.5	25.3	85	4.9	46.2	11.0	134.3	-56.9	73.4	112.5
29-Apr	14	30	77.0	33.0	44.00	621.8	20.7	25.9	80	4.8	46.4	11.1	133.7	-61.5	63.8	117.5
29-Apr	18	30	80.0	35.0	45.00	625.8	22.3	26.1	86	4.9	48.0	11.6	132.3	-63.2	59.7	118.1
30-Apr	0	35	80.0	35.0	45.00	631.9	21.2	26.3	80	4.9	48.0	11.9	129.0	-61.7	61.2	113.6
30-Apr	7	50	83.0	36.1	46.90	639.2	23.0	26.6	86	4.9	48.4	12.4	124.8	-64.0	54.7	112.2
30-Apr	10	59	83.0	36.1	46.90	642.3	21.7	26.8	81	4.9			ERR		ERR	ERR
30-Apr	11	0	0.0	0.0	0.00	642.3	23.0	26.8	86	ERR			ERR		ERR	ERR
30-Apr	13	34	0.0	0.0	0.00	644.9	21.7	26.9	81	ERR			ERR		ERR	ERR
30-Apr	13	35	37.0	0.4	36.60	644.9	23.1	26.9	86	1.2	21.0	14.5	46.3	0.4	46.3	-0.3

Table C-1 Operating Data -- Electrical (Continued)

DATE	TIME hr	TIME mi	Power at Array in kW Forw.	Power at Array in kW Refl.	Input Power in kW	Elapsed Time hours	Equiv. Days at 40 kW	Elapsed Days	Source Utilization %	VSWR	Vector Voltmeter Va mV	Vector Voltmeter Vb mV	Z ohm	Angle degree	Z Real	Z Imaginary
30-Apr	21	30	38.0	0.3	37.70	652.8	21.9	27.2	80	1.2	20.5	14.0	46.8	0.2	46.8	-0.2
1-May	1	0	37.0	0.3	36.70	656.3	23.5	27.3	86	1.2	20.0	14.0	45.7	0.2	45.7	-0.2
1-May	7	50	40.0	0.4	39.60	663.2	22.3	27.6	81	1.2	20.0	14.5	44.1	0.8	44.1	-0.6
1-May	10	49	40.0	0.4	39.60	666.2	23.9	27.8	86	1.2			ERR		ERR	ERR
1-May	10	50	0.0	0.0	0.00	666.2	22.4	27.8	81	ERR			ERR		ERR	ERR
1-May	11	9	0.0	0.0	0.00	666.5	23.9	27.8	86	ERR			ERR		ERR	ERR
1-May	11	10	39.0	0.6	38.40	666.5	22.4	27.8	81	1.3	19.6	14.6	42.9	1.0	42.9	-0.7
1-May	14	29	39.0	0.6	38.40	669.8	24.0	27.9	86	1.3	19.4	14.5	42.8	1.0	42.8	-0.7
1-May	14	30	0.0	0.0	0.00	669.8	22.4	27.9	80	ERR			ERR		ERR	ERR
1-May	16	49	0.0	0.0	0.00	672.2	24.0	28.0	86	ERR			ERR		ERR	ERR
1-May	16	50	40.0	5.0	35.00	672.2	22.5	28.0	80	2.1	20.2	15.9	40.6	30.0	35.2	-20.3
2-May	12	0	39.0	4.8	34.20	691.3	24.4	28.8	85	2.1	19.4	16.8	36.9	29.8	32.0	-18.4
2-May	21	47	43.0	5.8	37.20	701.1	23.6	29.2	81	2.2	20.2	19.2	33.6	71.8	10.5	-32.0
3-May	0	14	43.0	5.8	37.20	703.6	24.8	29.3	85	2.2			ERR		ERR	ERR
3-May	0	15	0.0	0.0	0.00	703.6	23.6	29.3	81	ERR			ERR		ERR	ERR
3-May	0	54	0.0	0.0	0.00	704.2	24.8	29.3	85	ERR			ERR		ERR	ERR
3-May	0	55	44.0	6.0	38.00	704.3	23.6	29.3	81	2.2			ERR		ERR	ERR
3-May	8	20	44.0	6.5	37.50	711.7	25.0	29.7	84	2.2	20.4	18.8	34.7	35.0	28.4	-19.9
3-May	15	4	44.0	6.3	37.75	718.4	24.2	29.9	81	2.2			ERR		ERR	ERR
3-May	15	5	0.0	0.0	0.00	718.4	25.1	29.9	84	ERR			ERR		ERR	ERR
3-May	15	19	0.0	0.0	0.00	718.7	24.2	29.9	81	ERR			ERR		ERR	ERR
3-May	15	20	41.0	6.6	34.40	718.7	25.1	29.9	84	2.3	19.6	18.3	34.3	35.6	27.9	-19.9
4-May	6	59	42.0	6.5	35.50	734.3	24.5	30.6	80	2.3			ERR		ERR	ERR
4-May	7	0	0.0	0.0	0.00	734.3	25.4	30.6	83	ERR			ERR		ERR	ERR
4-May	7	34	0.0	0.0	0.00	734.9	24.5	30.6	80	ERR			ERR		ERR	ERR
4-May	7	35	43.6	7.0	36.60	734.9	25.4	30.6	83	2.3	20.6	18.2	36.2	36.4	29.1	-21.5
4-May	18	18	44.0	7.7	36.30	745.6	24.7	31.1	80	2.4	20.9	18.5	36.1	36.0	29.2	-21.2
4-May	23	35	45.0	8.4	36.60	750.9	26.0	31.3	83	2.5	21.2	18.7	36.3	41.1	27.3	-23.8

Table C-1 Operating Data -- Electrical (Continued)

DATE	TIME hr	TIME mi	Power at Array in kW Forw.	Power at Array in kW Refl.	Input Power in kW	Elapsed Time hours	Equiv. Days at 40 kW	Elapsed Days	Source Utilization %	VSWR	Vector Voltmeter Va mV	Vector Voltmeter Vb mV	Z ohm	Angle degree	Z Real	Z Imaginary
5–May	11	5	48.0	8.9	39.10	762.4	25.4	31.8	80	2.5	21.0	19.0	35.3	45.0	25.0	−25.0
5–May	17	58	46.0	9.5	36.50	769.3	26.7	32.1	83	2.7	21.0	19.0	35.3	44.0	25.4	−24.6
6–May	1	30	47.0	10.8	36.20	776.8	25.9	32.4	80	2.8	21.2	20.2	33.6	47.0	22.9	−24.5
6–May	8	6	46.5	11.0	35.50	783.4	27.2	32.6	83	2.9	21.6	20.0	34.5	49.5	22.4	−26.3
6–May	22	37	48.0	12.6	35.40	798.0	26.7	33.2	80	3.1	21.9	20.6	34.0	47.0	23.2	−24.9
7–May	1	30	48.5	13.0	35.50	800.8	27.9	33.4	84	3.1	21.9	20.5	34.2	47.5	23.1	−25.2
7–May	7	6	48.5	13.0	35.50	806.4	27.0	33.6	80	3.1			ERR		ERR	ERR
7–May	7	7	0.0	0.0	0.00	806.5	28.0	33.6	83	ERR			ERR		ERR	ERR
7–May	7	29	0.0	0.0	0.00	806.8	27.0	33.6	80	ERR			ERR		ERR	ERR
7–May	7	30	53.5	13.3	40.20	806.8	28.0	33.6	83	3.0	21.8	20.5	34.0	43.0	24.9	−23.2
7–May	20	28	53.0	14.0	39.00	819.8	27.3	34.2	80	3.1	21.7	21.0	33.0	42.0	24.6	−22.1
8–May	2	30	55.0	14.9	40.10	825.8	28.8	34.4	84	3.2	22.3	21.9	32.6	43.0	23.8	−22.2
8–May	6	59	55.0	15.0	40.00	830.3	27.7	34.6	80	3.2			ERR		ERR	ERR
8–May	7	0	0.0	0.0	0.00	830.3	28.9	34.6	84	ERR			ERR		ERR	ERR
8–May	10	44	0.0	0.0	0.00	834.1	27.8	34.8	80	ERR			ERR		ERR	ERR
8–May	10	45	56.5	16.1	40.40	834.1	29.0	34.8	83	3.3	22.6	21.5	33.6	51.5	20.9	−26.3
8–May	14	54	56.5	16.1	40.40	838.2	27.9	34.9	80	3.3			ERR		ERR	ERR
8–May	14	55	0.0	0.0	0.00	838.3	29.1	34.9	83	ERR			ERR		ERR	ERR
8–May	15	36	0.0	0.0	0.00	838.9	27.9	35.0	80	ERR			ERR		ERR	ERR
8–May	15	37	55.0	16.0	39.00	839.0	29.1	35.0	83	3.3	22.5	21.5	33.5	52.0	20.6	−26.4
9–May	0	10	56.0	16.5	39.50	847.5	28.1	35.3	80	3.4	22.8	21.8	33.4	52.0	20.6	−26.4
9–May	6	24	57.0	17.0	40.00	853.7	29.7	35.6	83	3.4	23.2	22.1	33.6	52.3	20.5	−26.6
9–May	21	50	56.4	18.0	38.40	869.2	29.0	36.2	80	3.6	22.8	22.7	32.1	55.2	18.3	−26.4
10–May	1	5	58.0	19.0	39.00	872.4	30.5	36.4	84	3.7	23.3	23.2	32.1	55.7	18.1	−26.5
10–May	21	56	59.9	20.0	39.90	893.3	29.9	37.2	80	3.7	23.7	26.0	29.2	57.3	15.7	−24.5
11–May	0	30	62.0	21.0	41.00	895.8	31.4	37.3	84	3.8	24.3	26.5	29.3	56.9	16.0	−24.6
11–May	8	0	63.0	21.9	41.10	903.3	30.4	37.6	81	3.9	24.4	23.6	33.1	57.6	17.7	−27.9
11–May	16	0	54.5	18.7	35.80	911.3	32.0	38.0	84	3.8	23.9	23.8	32.1	53.3	19.2	−25.7

Table C-1 Operating Data -- Electrical (Continued)

DATE	TIME hr	TIME mi	Power at Array in kW Forw.	Power at Array in kW Refl.	Input Power in kW	Elapsed Time hours	Equiv. Days at 40 kW	Elapsed Days	Source Utilization %	VSWR	Vector Voltmeter Va mV	Vector Voltmeter Vb mV	Z ohm	Angle degree	Z Real	Z Imaginary
11-May	16	29	54.5	18.7	35.80	911.8	30.7	38.0	81	3.8			ERR		ERR	ERR
11-May	16	30	0.0	0.0	0.00	911.8	32.1	38.0	84	ERR			ERR		ERR	ERR
12-May	3	55	64.0	24.5	39.50	923.3	31.2	38.5	81	4.2	25.6	24.8	33.0	61.8	15.6	-29.1
12-May	12	18	59.0	20.5	38.50	931.6	32.5	38.8	84	3.9	23.1	22.8	32.4	56.0	18.1	-26.9
12-May	19	55	55.5	19.0	36.50	939.3	31.8	39.1	81	3.8	22.3	22.0	32.4	53.9	19.1	-26.2
13-May	2	0	56.5	17.5	39.00	945.3	33.0	39.4	84	3.5	22.5	22.2	32.4	52.9	19.6	-25.9
13-May	13	20	52.5	12.5	40.00	956.7	32.5	39.9	82	2.9	20.6	21.1	31.2	47.1	21.3	-22.9
13-May	21	55	51.5	14.0	37.50	965.3	33.8	40.2	84	3.2	20.7	21.0	31.5	47.3	21.4	-23.2
14-May	4	0	54.0	15.0	39.00	971.3	33.1	40.5	82	3.2	21.4	21.7	31.5	48.6	20.9	-23.7
14-May	15	55	51.5	14.3	37.20	983.3	34.5	41.0	84	3.2	20.4	21.0	31.1	46.6	21.3	-22.6
14-May	21	55	52.5	14.3	38.20	989.3	33.8	41.2	82	3.2	20.8	21.2	31.4	46.0	21.8	-22.6
15-May	0	37	52.2	13.0	39.20	992.0	34.8	41.3	84	3.0	21.2	21.5	31.5	47.2	21.4	-23.1
15-May	6	40	52.2	14.5	37.70	998.0	34.2	41.6	82	3.2	21.1	21.6	31.2	46.9	21.3	-22.8
15-May	8	30	56.0	15.2	40.80	999.8	35.2	41.7	84	3.2	20.6	21.5	30.6	46.0	21.3	-22.0
15-May	11	44	56.0	15.2	40.80	1003.1	34.4	41.8	82	3.2			ERR		ERR	ERR
15-May	11	45	0.0	0.0	0.00	1003.1	35.2	41.8	84	ERR			ERR		ERR	ERR
15-May	12	4	0.0	0.0	0.00	1003.4	34.4	41.8	82	ERR			ERR		ERR	ERR
15-May	12	5	54.0	15.1	38.90	1003.4	35.3	41.8	84	3.2	20.5	21.2	30.9	46.4	21.3	-22.4
15-May	21	43	52.0	15.0	37.00	1013.1	34.6	42.2	82	3.3	20.4	21.3	30.6	47.3	20.8	-22.5
16-May	1	5	53.0	15.2	37.80	1016.4	35.8	42.4	84	3.3	20.9	21.7	30.8	46.8	21.1	-22.5
16-May	4	2	53.0	15.2	37.80	1019.4	34.8	42.5	82	3.3	20.2	20.9	30.9	43.6	22.4	-21.3
16-May	9	55	48.0	9.4	38.60	1025.3	36.1	42.7	85	2.6	18.1	19.4	29.8	36.7	23.9	-17.8
16-May	20	2	46.0	8.5	37.50	1035.4	35.4	43.1	82	2.5	18.0	19.3	29.8	34.5	24.6	-16.9
16-May	21	40	46.0	8.5	37.50	1037.0	36.6	43.2	85	2.5	18.1	19.3	30.0	34.0	24.9	-16.8
17-May	0	28	46.0	8.3	37.70	1039.8	35.6	43.3	82	2.5	18.2	19.3	30.2	34.0	25.0	-16.9
17-May	8	40	46.2	7.4	38.80	1048.0	37.0	43.7	85	2.3	18.0	19.0	30.3	30.0	26.2	-15.1
17-May	12	0	0.0	0.0	0.00	1051.3	35.8	43.8	82	ERR			ERR		ERR	ERR
17-May	12	34	0.0	0.0	0.00	1051.9	37.1	43.8	85	ERR			ERR		ERR	ERR

Table C-1 Operating Data -- Electrical (Continued)

DATE	TIME hr	TIME mi	Power at Array in kW Forw.	Power at Array in kW Refl.	Input Power in kW	Elapsed Time hours	Equiv. Days at 40 kW	Elapsed Days	Source Utilization %	VSWR	Vector Voltmeter Va mV	Vector Voltmeter Vb mV	Z ohm	Angle degree	Z Real	Z Imaginary
17-May	12	35	45.6	7.9	37.70	1051.9	35.8	43.8	82	2.4			ERR		ERR	ERR
17-May	15	5	0.0	0.0	0.00	1054.4	37.1	43.9	84	ERR			ERR		ERR	ERR
17-May	15	34	0.0	0.0	0.00	1054.9	35.9	44.0	82	ERR			ERR		ERR	ERR
17-May	15	35	45.0	7.5	37.50	1054.9	37.1	44.0	84	2.4			ERR		ERR	ERR
17-May	21	0	44.0	7.5	36.50	1060.3	36.0	44.2	81	2.4	17.3	18.8	29.4	29.5	25.6	-14.5
18-May	4	35	44.0	6.5	37.50	1067.9	37.6	44.5	85	2.2	16.6	18.5	28.7	23.1	26.4	-11.3
18-May	6	0	44.0	6.0	38.00	1069.3	36.4	44.6	82	2.2	16.8	18.5	29.0	22.1	26.9	-10.9
18-May	8	45	45.5	6.5	39.00	1072.1	37.8	44.7	85	2.2	16.9	18.8	28.7	23.0	26.5	-11.2
18-May	13	30	43.0	4.9	38.10	1076.8	36.7	44.9	82	2.0	17.0	18.1	30.0	17.6	28.6	-9.1
18-May	16	0	41.8	4.0	37.80	1079.3	38.1	45.0	85	1.9	16.9	17.2	31.4	15.7	30.2	-8.5
18-May	23	40	18.0	2.5	15.50	1087.0	36.9	45.3	82	2.2	20.4	7.5	87.0	33.5	72.5	-48.0
18-May	23	55	0.0	0.0	0.00	1087.3	38.2	45.3	84	ERR			ERR		ERR	ERR
19-May	1	15	0.0	0.0	0.00	1088.6	36.9	45.4	81	ERR			ERR		ERR	ERR
19-May	1	15	21.0	0.7	20.30	1088.6	38.2	45.4	84	1.4			ERR		ERR	ERR
19-May	5	58	21.5	0.8	20.70	1093.3	37.0	45.6	81	1.5	20.3	8.0	81.1	-1.0	81.1	1.4
19-May	7	55	22.0	0.8	21.20	1095.3	38.4	45.6	84	1.5	20.0	7.8	82.0	-0.1	82.0	0.1
19-May	10	0	35.5	2.0	33.50	1097.3	37.1	45.7	81	1.6	25.1	9.4	85.4	16.0	82.1	-23.5
19-May	11	11	34.0	0.8	33.20	1098.5	38.5	45.8	84	1.4	23.4	9.9	75.6	-2.4	75.5	3.2
19-May	14	13	33.0	0.7	32.30	1101.6	37.3	45.9	81	1.3	22.3	10.0	71.3	-4.0	71.1	5.0
19-May	14	23	38.0	0.8	37.20	1101.7	38.6	45.9	84	1.3	24.0	10.8	71.1	-3.4	70.9	4.2
19-May	15	23	36.5	0.5	36.00	1102.7	37.3	45.9	81	1.3	23.0	11.4	64.5	-7.8	63.9	8.8
19-May	17	0	38.0	0.8	37.20	1104.3	38.7	46.0	84	1.3	24.0	10.0	76.8	3.5	76.6	-4.7
19-May	19	0	38.0	2.5	35.50	1106.3	37.4	46.1	81	1.7	25.0	11.8	67.8	15.0	65.4	-17.5
19-May	20	0	42.5	6.5	36.00	1107.3	38.8	46.1	84	2.3	26.5	13.3	63.7	43.0	46.6	-43.5
19-May	23	55	33.0	3.0	30.00	1111.3	37.6	46.3	81	1.9	21.5	12.7	54.1	32.0	45.9	-28.7
20-May	4	22	26.0	6.0	20.00	1115.7	39.1	46.5	84	2.8	22.0	10.5	67.0	46.0	46.5	-48.2
20-May	5	49	7.0	0.0	7.00	1117.2	37.7	46.5	81	1.0	23.0	5.7	129.0	64.0	56.6	-116.0
20-May	6	25	0.0	0.0	0.00	1117.8	39.1	46.6	84	ERR			ERR		ERR	ERR

Table C-1 Operating Data -- Electrical (Continued)

DATE	TIME hr	TIME mi	Power at Array in kW Forw.	Power at Array in kW Refl.	Input Power in kW	Elapsed Time hours	Equiv. Days at 40 kW	Elapsed Days	Source Utilization %	VSWR	Vector Voltmeter Va mV	Vector Voltmeter Vb mV	Z ohm	Angle degree	Z Real	Z Imaginary
20-May	7	30	31.0	15.0	16.00	1118.8	37.7	46.6	81	5.6	29.0	9.0	103.0	63.5	46.0	-92.2
20-May	7	31	0.0	0.0	0.00	1118.9	39.1	46.6	84	ERR			ERR		ERR	ERR
20-May	18	29	0.0	0.0	[illegible]	1129.8	37.8	47.1	80	ERR			ERR		ERR	ERR
20-May	18	30	12.0	2.0	10.00	1129.8	39.1	47.1	83	2.4	16.0	5.5	93.0	30.5	80.2	-47.2
20-May	18	53	24.0	3.6	20.40	1130.2	37.8	47.1	80	2.3	22.3	7.9	90.3	30.1	78.1	-45.3
21-May	0	25	22.5	3.0	19.50	1135.8	39.2	47.3	83	2.2	21.7	8.4	82.6	29.5	71.9	-40.7
21-May	1	18	10.0	0.0	10.00	1136.6	37.9	47.4	80	1.0	11.5	6.0	61.3	0.0	61.3	0.0
21-May	3	31	11.0	1.1	9.90	1138.9	39.3	47.5	83	1.9	15.5	5.6	88.5	24.7	80.4	-37.0
21-May	5	23	11.0	1.0	10.00	1140.7	38.0	47.5	80	1.9	14.7	6.0	78.4	23.0	72.1	-30.6
21-May	5	30	16.0	1.5	14.50	1140.8	39.3	47.5	83	1.9	17.6	7.2	78.2	23.5	71.7	-31.2
21-May	8	15	23.0	2.1	20.90	1143.6	38.0	47.6	80	1.9	20.4	8.4	77.7	25.3	70.2	-33.2
21-May	8	55	10.0	0.0	10.00	1144.3	39.3	47.7	83	1.0	11.3	6.6	54.8	-5.0	54.5	4.8
21-May	9	28	17.0	1.9	15.10	1144.8	38.0	47.7	80	2.0	18.0	10.0	57.6	25.9	51.8	-25.1
21-May	13	15	16.0	0.3	15.70	1148.6	39.4	47.9	82	1.3	13.0	8.6	48.3	4.0	48.2	-3.4
21-May	23	6	22.0	2.5	19.50	1158.4	38.3	48.3	79	2.0	17.1	11.0	49.7	-40.0	38.1	32.0
22-May	0	49	32	7.3	24.70	1160.2	39.6	48.3	82	2.8	29.5	5.9	159.9	-33.3	133.6	87.8
22-May	1	57	46.0	16.0	30.00	1161.3	38.4	48.4	79	3.9	38.0	6.0	202.5	-51.8	125.3	159.2
22-May	4	18	66.0	22.0	44.00	1163.6	39.8	48.5	82	3.7	45.0	8.0	179.9	-56.4	99.5	149.8
22-May	7	40	35.0	0.0	35.00	1167.0	38.6	48.6	79	1.0	48.0	8.2	187.2	-54.5	108.7	152.4
22-May	12	20	30.0	0.0	30.00	1171.7	40.1	48.8	82	1.0	46.0	9.7	151.7	-54.3	88.5	123.2
22-May	16	25	35.0	0.0	35.00	1175.8	38.9	49.0	79	1.0	49.5	8.4	188.2	-53.7	111.4	151.7
22-May	21	24	35.0	0.1	34.90	1180.7	40.4	49.2	82	1.1	51.8	8.3	199.6	-54.5	115.9	162.5
22-May	23	29	38.0	0.1	37.90	1182.8	39.1	49.3	79	1.1	51.0	8.6	189.6	-50.6	120.4	146.5
23-May	1	14	39.8	0.1	39.70	1184.6	40.5	49.4	82	1.1	54.2	8.8	197.0	-53.9	116.1	159.1
23-May	5	29	37.0	0.1	36.90	1188.8	39.4	49.5	79	1.1	51.0	8.0	203.9	-48.2	135.9	152.0
23-May	20	8	36.0	0.0	36.00	1203.5	41.3	50.1	82	1.0	46.1	10.4	141.8	-59.0	73.0	121.5
24-May	6	0	10.0	0.1	9.90	1213.3	40.0	50.6	79	1.2			ERR		ERR	ERR
24-May	6	43	15.0	0.0	15.00	1214.1	41.6	50.6	82	1.0	8.1	13.0	19.9	-5.0	19.9	1.7

IITRI OPERATING DATA

Date	Time	Inlet Air Flow (CFM)	Inlet Air Pres (psi)	Vapor Temp (F)	Suction (in Water)	Discharge (in Water)	Mixed Vapor Flow (CFM)	Mixed Vapor Press (psi)	Mixed Vapor Temp (F)	Ambient Temp (F)	Vapor Flow (SCFM)
4/3/93	15:30	70	66	90	12	17	170	0.4	65		100
	16:35										
	18:25	70	66	90	13	17	170	0.6	65		100
	20:25	70	66	85	13	16	170	0.5	65		100
	23:10	70	66	85	13	18	170	0.4	68		100
4/4/93	1:30	70	66	88	13	18	180	0.6	60		110
	4:30	70	66	87	13	18	180	0.6	60		110
	6:25	70	66	86	13	18	180	0.5	60		110
	9:27	70	67	85	13	18	180	0.5	66		110
	11:45	70	68	90	13	18	180	0.5	66		110
	14:30	70	67	91	13	17	180	0.5	80		110
	16:30	70	66	90	13	18	180	0.6	80		110
	18:40	70	68	90	13	17	180	0.5	80		110
	20:30	70	67	90	12	16	180	0.4	65		110
	22:30	70	67	88	12	17	180	0.5	65		110
4/5/93	0:32	70	67	88	12	16	180	0.6	70		110
	2:25	70	67	91	12	16	180	0.7	70		110
	4:29	70	67	90	12	16	180	0.7	67		110
	6:27	70	67	90	11	16	180	0.7	67		110
	8:30	70	67	93	11	16	180	0.5	70		110
	10:30	65				16					
	11:40	75	78	105	11	16	190	0.6	90	56	115
	13:35	70	78	107	11	16	190	0.5	90	70	120
	15:40	70	79	115	10	15	190	0.5	110	72	120
	17:30	65	79	120	10	15	190	0.5	100	74	125
	19:30	65	79	120	10	15	190	0.4	90		125
	23:30	70	78	111	10	15	190	0.6	81		120
4/6/93	1:30	70	78	111	10	15	180	0.6	84		110
	3:30	70	78	112	10	14	190	0.6	84		120
	5:30	70	78	113	10	14	190	0.5	85		120
	7:30	70	78	115	10	14	180	0.5	90	56	110
	9:35	70	78	115	10	15	180	0.6	90	70	110
	11:30	70	78	116	10	15	180	0.5	90	72	110
	13:28	71	79	120	11	14	179	0.5	91	74	108
	16:00	71	78	120	10	14	180	0.4	90	74	109
	18:00	70	79	120	10	14	180	0.5	90	70	110
	20:00	70	78	120	9	14	180	0.5	90	68	110
	22:00	70	79	119	9	14	190	0.5	85	68	120
4/7/93	0:01	70	78	119	9	14	180	0.6	91	67	110
	1:55	70	78	119	9	14	180	0.6	91	67	110
	4:00	70	78	119	8	14	190	0.5	94	67	120
	6:05	70	78	120	9	14	180	0.5	94	66	110
	8:00	70	79	121	9	14	180	0.5	100	70	110
	10:00	70	78	121	9	14	180	0.6	100	72	110
	12:02	69	78	120	10	14	180	0.5	100	62	111
	13:55	70	78	130	12	17	190	0.6	110	80	120
	15:55	70	78	139	12	17	190	0.6	115	82	120
	18:00	70	78	140	12	17	180	0.5	110	74	110
	20:00	70	78	135	12	16	190	0.5	110	65	120
	22:00	69	79	135	12	16	185	0.6	110	64	116
4/8/94	0:02	70	78	134	12	16	190	0.5	100	62	120
	2:00	70	78	133	12	16	190	0.5	105	62	120
	4:00	70	78	131	12	15	190	0.5	104	63	120
	6:00	70	77	129	12	16	180	0.5	103	62	110
	8:00	70	78	129	12	15	190	0.6	103	62	120

IITRI OPERATING DATA

Date	Time	Inlet Air Flow (CFM)	Inlet Air Pres (psi)	Vapor Temp (F)	Suction (in Water)	Discharge (in Water)	Mixed Vapor Flow (CFM)	Mixed Vapor Press (psi)	Mixed Vapor Temp (F)	Ambient Temp (F)	Vapor Flow (SCFM)
	10:00	70	78	130	12	16	190	0.6	105	74	120
	12:00	65	78	137	12	16	190	0.6	110	82	125
	14:00	65	78	140	12	16	190	0.6	110	86	125
	16:00	70	78	140	12	16	190	0.6	115	82	120
	18:00	70	78	140	11	17	190	0.5	110	70	120
	20:00	70	78	138	11	15	190	0.5	115	68	120
	22:00	70	78	140	12	17	190	0.6	110	62	120
4/9/94	0:01	70	78	135	11	15	190	0.6	107	56	120
	2:00	70	78	132	11	15	180	0.6	104	53	110
	4:00	70	78	131	11	15	190	0.6	104	50	120
	6:00	70	78	131	11	15	190	0.6	105	48	120
	8:00	70	78	131	11	15	190	0.6	105	72	120
	10:00	70	78	130	11	15	190	0.5	110		120
	12:05	70	78	135	11	15	190	0.5	110		120
	14:00	70	78	142	12	16	195	0.4	120	95	125
	16:00	70	78	145	12	16	195	0.4	118		125
	18:00	70	78	146	11	16	195	0.4	118		125
	20:00	70	78	147	11	16	190	0.4	118	78	120
	22:00	75	78	145	11	16	190	0.4	115	70	115
4/10/94	0:01	75	78	145	11	15	190	0.5	113	57	115
	2:00	75	78	142	11	15	180	0.5	113	52	105
	4:04	75	78	139	11	15	180	0.5	113	49	105
	6:00	75	78	139	11	15	193	0.5	113	48	118
	8:00	70	78	139	11	15	195	0.4	120	70	125
	10:00	70	78	140	11	15	195	0.4	125		125
	12:00	70	78	143	11	15	195	0.4	125		125
	14:00	70	78	147	11	15	195	0.4	130		125
	16:00	70	78	150	11	15	195	0.4	125	88	125
	18:00	70	78	151	11	15	195	0.4	121		125
	20:00	70	78	151	11	15	195	0.4	120		125
	22:00	70	78	149	11	15	190	0.4	115		120
4/11/93	0:01	70	78	145	11	15	180	0.5	117	68	110
	2:00	70	78	143	11	15	180	0.5	117	68	110
	4:00	70	78	143	11	15	180	0.4	117	64	110
	6:00	70	78	144	10	15	180	0.4	120	62	110
	8:00	70	78	145	10	15	190	0.4	120	59	120
	10:00	70	78	146	10	15	190	0.4	125	72	120
	12:00	70	78	150	10	15	190	0.4	130	76	120
	14:00	70	78	155	11	15	190	0.4	130		120
	16:00	70	78	154	12	15	190	0.5	130		120
	18:00	69	78	155	12	15	195	0.4	125	82	126
	20:00	66	78	145	10	15	195	0.4	115	78	129
	22:00	68	77	145	11	15	190	0.5	120	76	122
4/12/93	0:01	64	77	142	11	15	180	0.4	111	69	116
	2:00	63	78	142	11	15	180	0.4	113	68	117
	4:00	65	78	143	11	15	180	0.4	115	68	115
	6:00	65	78	144	10	15	185	0.4	115	67	120
	8:00	65	78	145	10	15	190	0.4	120		125
	10:00	65	78	145	10	15	190	0.3	125		125
	12:00	65	78	145	10	15	190	0.4	125	78	125
	14:00										
	16:00	71	89	155	10	14	197	0.4	125	88	126
	18:00	71	88	155	11	14	195	0.4	120	82	124
	20:00	71	88	150	10	14	195	0.4	120	78	124
	22:00	70	88	145	10	14	200	0.4	120	72	130

IITRI OPERATING DATA

Date	Time	Inlet Air Flow (CFM)	Inlet Air Pres (psi)	Vapor Temp (F)	Suction (in Water)	Discharge (in Water)	Mixed Vapor Flow (CFM)	Mixed Vapor Press (psi)	Mixed Vapor Temp (F)	Ambient Temp (F)	Vapor Flow (SCFM)
4/13/93	0:01	70	88	146	10	14	190	0.4	116	70	120
	2:00	75	88	146	10	14	190	0.4	118	70	115
	4:00	75	88	147	10	14	190	0.4	120	70	115
	6:00	75	88	147	10	14	190	0.4	120	70	115
	8:00	75	88	147	10	14	195	0.4	125		120
	10:00	75	88	148	10	14	195	0.4	120		120
	12:00	75	88	148	10	14	195	0.4	120		120
	14:00	80	88	150	10	14	195	0.4	125		115
	16:00	80	88	150	10	14	195	0.4	120		115
	18:00	80	89	150	11	14	195	0.4	118	78	115
	20:00	78	87	150	10	14	195	0.4	120	72	117
	22:00	80	86	150	10	14	200	0.4	120	70	120
4/14/93	0:01	78	87	148	9	14	190	0.4	118	70	112
	2:00	78	86	149	10	14	190	0.4	120	70	112
	4:00	78	87	148	9	13	190	0.4	118	69	112
	6:00	78	88	149	9	13	190	0.4	120	68	112
	8:00	70	88	149	9	13	190	0.4	120		120
	10:00	75	88	150	10	13	190	0.4	120		115
	12:00	75	88	150	10	14	190	0.4	125		115
	14:00	75	90	150	10	14	195	0.4	125		120
	16:00	75	89	150	10	14	196	0.4	124	86	121
	18:00	80	89	150	9	13	197	0.4	125	76	117
	20:00	80	89	151	10	14	195	0.4	125	60	115
	22:00	75	89	145	10	14	200	0.4	115	53	125
4/15/93	0:01	75	88	145	9	13	195	0.4	112	49	120
	2:00	75	88	145	9	13	195	0.4	112	49	120
	4:00	75	89	144	9	13	195	0.4	113	48	120
	6:00	70	90	144	9	13	200	0.4	114	45	130
	8:00	75	90	145	9	13	200	0.4	115		125
	10:00	75	89	146	9	13	200	0.4	115		125
	12:00	75	90	150	9	13	200	0.4	117		125
	14:00	75	90	152	9	13	200	0.4	120		125
	16:00	70	90	156	9	13	200	0.4	120	86	130
	18:00	70	90	155	9	13	200	0.4	120	75	130
	20:00	75	90	155	9	13	200	0.4	120	72	125
	22:00	75	90	155	9	13	200	0.4	120	60	125
4/16/93	0:01	80	90	145	9	13	200	0.4	115	58	120
	2:00	80	89	145	9	13	200	0.4	114	53	120
	4:00	80	89	144	9	13	200	0.4	115	50	120
	6:00	80	89	144	9	13	200	0.4	114	49	120
	8:00	80	89	145	9	13	200	0.4	115	64	120
	10:00	80	89	146	9	13	200	0.4	115		120
	12:00	80	90	150	9	13	200	0.4	120	78	120
	14:00	80	90	150	9	13	200	0.4	120		120
	16:00	80	89	150	8	13	200	0.4	120	80	120
	18:00	80	89	150	8	12	200	0.4	120	72	120
	20:00	75	88	145	8	12	200	0.4	115	66	125
	22:00	75	89	145	8	12	200	0.4	115	60	125
4/17/93	0:01	70	88	143	8	12	200	0.4	110	60	130
	2:00	75	87	140	8	12	195	0.4	110	58	120
	4:00	75	87	142	8	12	195	0.4	110	58	120
	6:00	70	87	142	8	12	195	0.5	111	59	125
	8:00	70	88	142	8	12	195	0.4	112	65	125
	10:00	70	8	146	8	13	195	0.5	115		125
	12:00	70	88	144	8	15	195	0.4	115		125

IITRI OPERATING DATA

Date	Time	Inlet Air Flow (CFM)	Inlet Air Pres (psi)	Vapor Temp (F)	Suction (in Water)	Discharge (in Water)	Mixed Vapor Flow (CFM)	Mixed Vapor Press (psi)	Mixed Vapor Temp (F)	Ambient Temp (F)	Vapor Flow (SCFM)
	14:00	70	88	146	8	16	200	0.4	120	88	130
	16:00	70	89	150	8	16	200	0.4	120	88	130
	18:00	70	88	150	9	16	200	0.4	125	89	130
	20:00	75	88	143	8	16	200	0.4	120	69	125
	22:00	75	87	135	8	16	200	0.4	105	68	125
4/18/93	0:01										
	1:10	75	87	133	8	16	200	0.4	104	64	125
	2:00	75	87	137	8	16	200	0.4	105	63	125
	4:00	75	88	137	8	16	200	0.4	106	61	125
	6:00	70	88	138	8	16	200	0.4	108	62	130
	8:00	70	88	140	8	16	200	0.4	110	65	130
	10:00	70	88	141	8	16	200	0.4	111	68	130
	12:00	70	88	146	8	16	200	0.4	116	75	130
	14:00	70	88	147	8	16	200	0.4	120	92	130
	16:00	70	89	150	8	16	200	0.4	120	92	130
	18:00	70	88	150	8	16	200	0.4	120	88	130
	20:00	70	89	150	8	16	200	0.4	120	80	130
	22:00	70	86	140	8	115	200	0.4	110	75	130
4/19/93	0:01	70	87	139	8	15	195	0.4	110	66	125
	2:00	70	87	139	8	15	195	0.4	110	66	125
	4:00	70	87	139	8	15	200	0.4	110	66	130
	6:00	65	87	139	8	15	200	0.4	111	66	135
	8:00	65	88	142	8	15	200	0.4	111		135
	10:00	65	89	145	8	15	200	0.4	113		135
	12:00	70	88	149	8	15	200	0.4	120		130
	14:00	70	88	151	8	15	200	0.4	120		130
	16:00	70	88	150	8	15	200	0.4	120	88	130
	18:00	70	88	150	8	15	200	0.4	118	85	130
	20:00	70	87	149	8	15	200	0.4	115	82	130
	22:00	70	88	144	8	15	200	0.4	110	70	130
4/20/93	0:01	65	86	142	8	15	195	0.4	110	69	130
	2:00	65	87	143	8	15	200	0.4	113	70	135
	4:00	60	87	144	8	15	200	0.4	114	70	140
	6:00	60	87	144	8	15	200	0.4	114	68	140
	8:00	60	88	145	8	15	200	0.4	115	70	140
	10:00	60	88	145	8	15	200	0.4	115	70	140
	12:00	60	88	145	8	15	200	0.4	115	72	140
	14:00	60	88	145	8	15	200	0.4	115	78	140
	16:00	60	89	139	8	15	200	0.4	115	78	140
	18:00	60	88	140	8	15	200	0.4	115	74	140
	20:00	80	89	145	8	15	200	0.4	120	70	120
	22:00	80	89	140	8	15	200	0.4	110	62	120
4/21/93	0:01	80	89	138	8	15	200	0.4	107	60	120
	2:00	80	88	135	8	15	200	0.4	105	57	120
	4:00	80	88	135	8	15	200	0.4	106	54	120
	6:00	78	88	135	8	15	200	0.4	106	54	122
	8:00	79	88	135	8	15	200	0.4	108	57	121
	10:00	80	89	137	8	15	200	0.4	111	60	120
	12:00	75	89	143	8	15	200	0.4	115	75	125
	14:00	75	89	142	8	16	200	0.4	111	75	125
	16:00	65	90	145	8	16	200	0.4	110	76	135
	18:00	65	90	145	8	16	200	0.4	110	74	135
	20:00	65	90	145	8	16	200	0.4	110	72	135
	22:00	65	90	145	8	15	200	0.4	107		135
4/22/94	0:01	90	88	136	8	15	200	0.4	104	59	110

IITRI OPERATING DATA

Date	Time	Inlet Air Flow (CFM)	Inlet Air Pres (psi)	Vapor Temp (F)	Suction (in Water)	Discharge (in Water)	Mixed Vapor Flow (CFM)	Mixed Vapor Press (psi)	Mixed Vapor Temp (F)	Ambient Temp (F)	Vapor Flow (SCFM)
	2:00	90	89	137	8	15	200	0.4	106	54	110
	4:00	90	89	137	8	15	200	0.4	106	50	110
	6:00	90	88	137	8	15	200	0.4	106	50	110
	8:00	90	88	137	8	15	200	0.4	110	60	110
	10:00	90	88	139	8	15	200	0.4	115	70	110
	12:00	85	88	145	8	15	200	0.4	115	72	115
	14:00	70	87	145	8	16	200	0.4	115	75	130
	16:00	75	87	143	8	16	200	0.4	115	75	125
	18:00	70	87	142	8	16	200	0.4	115	75	130
	20:00	80	88	142	8	16	200	0.4	115	72	120
	22:00	85	86	142	8	16	200	0.4	115	70	115
	24:00	85	86	140	8	16	200	0.4	110	67	115
4/23/93	2:00	90	84	135	8	15	200	0.4	110	60	110
	4:00	90	84	135	8	15	200	0.4	105	58	110
	6:00	90	84	134	8	15	200	0.4	105	56	110
	8:00	90	84	137	8	15	200	0.4	105	66	110
	10:00	85	84	142	8	15	200	0.4	110	75	115
	12:00	75	85	146	8	15	200	0.4	115	81	125
	14:00	75	84	145	8	15	200	0.4	115	85	125
	16:00	85	85	146	8	15	200	0.4	114	86	115
	18:00	85	84	146	8	15	190	0.4	112	86	105
	20:00	80	84	143	8	15	190	0.4	108	78	110
	22:00	80	84	138	8	15	195	0.4	102	72	115
	24:00	85	84	140	8	15	200	0.4	100	70	115
4/24/93	2:00	85	84	140	8	15	200	0.4	100	70	115
	4:00	85	84	142	8	15	200	0.4	100	67	115
	6:00	85	84	140	8	15	200	0.4	100	66	115
	8:00	85	84	142	8	15	200	0.4	105	70	115
	10:00	80	84	142	8	15	200	0.4	110	72	120
	12:00	80	84	143	8	15	200	0.4	110	74	120
	14:00	80	84	145	8	15	200	0.4	110	80	120
	16:08	80	85	149	7	15	190	0.4	117	80	110
	18:00	85	85	150	7	15	200	0.4	114	80	115
	20:00	80	84	145	7	15	200	0.4	109	75	120
	22:00	80	84	139	7	15	200	0.4	105	72	120
	24:00	80	84	140	7	15	200	0.4	100	72	120
4/25/93	2:00	75	84	142	7	15	200	0.4	100	71	125
	4:00	70	84	143	8	15	200	0.4	100	72	130
	6:00	70	84	145	7	15	200	0.4	100	72	130
	8:00	70	84	145	8	15	200	0.4	110	70	130
	10:00	70	83	147	8	15	200	0.4	110	74	130
	12:00	65	84	146	8	16	200	0.4	115	83	135
	14:00	70	84	148	8	16	200	0.4	120	85	130
	16:00	70	85	151	8	16	190	0.4	121	88	120
	18:00	75	85	151	8	15	190	0.4	117	85	115
	20:00	70	84	147	8	15	200	0.4	111	80	130
	22:00	70	85	141	8	15	200	0.4	105	75	130
	24:00	70	86	140	8	15	200	0.4	105	74	130
4/26/93	2:00	70	86	141	8	15	200	0.4	105	72	130
	4:00	70	86	140	8	15	200	0.4	105	71	130
	6:00	70	86	140	8	15	200	0.4	105		130
	8:00	70	87	141	8	15	200	0.4	108	73	130
	10:00	70	85	145	7.5	15	200	0.4	115	78	130
	12:00	70	86	145	7.5	15	200	0.4	115	83	130
	14:00	65	87	150	7.5	15	200	0.4	118	90	135

IITRI OPERATING DATA

Date	Time	Inlet Air Flow (CFM)	Inlet Air Pres (psi)	Vapor Temp (F)	Suction (in Water)	Discharge (in Water)	Mixed Vapor Flow (CFM)	Mixed Vapor Press (psi)	Mixed Vapor Temp (F)	Ambient Temp (F)	Vapor Flow (SCFM)
	16:00	70	87	153	8	15	200	0.4	117	80	130
	18:00	70	87	153	8	15	200	0.4	110	80	130
	20:00	80	86	149	8	15	200	0.4	111	76	120
	22:00	75	86	142	8	15	200	0.4	106	71	125
	24:00	70	84	142	7.5	15	200	0.4	105	66	130
4/27/93	2:00	70	84	141	7.5	15	200	0.4	105	64	130
	4:00	8	84	145	7.5	15	200	0.4	105	60	192
	6:00	75	86	145	7.5	15	200	0.4	103	60	125
	8:00	75	85	141	7.5	15	200	0.4	110	62	125
	10:00	75	85	14	7.5	15	200	0.4	110	70	125
	12:00	75	85	147	7.5	15	200	0.4	115	72	125
	14:00	75	85	145	7.5	15	200	0.4	115	76	125
	16:00	75	85	146	7.5	15	200	0.4	115	76	125
	18:00	71	85	148	7.5	15	200	0.4	111	72	129
	20:00	70	84	145	7.5	15	200	0.4	105	68	130
	22:00	75	84	140	7.5	15	200	0.4	105	68	125
	24:00	75	84	143	7.5	15	200	0.4	105	66	125
4/28/93	2:00	75	84	143	7.5	15	200	0.4	105	65	125
	4:00	75	84	145	7.5	15	200	0.4	104	64	125
	6:00	75	84	145	7.5	15	200	0.4	107	64	125
	8:00	75	84	145	7.5	15	200	0.4	111	65	125
	10:00	70	84	145	7.5	15	200	0.4	111	70	130
	12:00	70	84	145	7.5	15	200	0.4	109	72	130
	14:00	70	84	145	7.5	15	200	0.4	110	76	130
	16:00	70	84	147	7.5	15	200	0.4	112	71	130
	18:00	70	84	148	7.5	15	200	0.4	112	72	130
	20:00	70	84	148	7.5	15	200	0.4	111	71	130
	22:00	70	84	147	7.5	15	200	0.4	110	70	130
	24:00	70	84	147	7.5	15	200	0.4	108	70	130
4/29/93	2:00	70	84	148	7.5	15	200	0.4	107	68	130
	4:00	70	84	149	7.5	15	200	0.4	105	67	130
	6:00	70	85	150	7.5	15	200	0.4	105	66	130
	8:00	69	85	145	7.5	15	200	0.4	108	70	131
	10:00	70	84	155	7.5	15	200	0.4	140	72	130
	12:00	70	84	160	7.5	15	200	0.4	145	68	130
	14:00	70	85	170	8.5	16	200	0.4	140	68	130
	16:00	70	84	167	8.5	16	200	0.4	135	62	130
	18:00	70	84	166	8.5	16	195	0.4	135	63	125
	20:00	70	85	165	8.5	16	200	0.4	135	63	130
	22:00	70	85	164	8.5	16	200	0.4	137	62	130
	24:00	70	86	165	8.5	16	200	0.4	140	62	130
4/30/93	2:00	70	85	165	8.5	16	200	0.4	140	61	130
	4:00	70	85	163	8.5	16	200	0.4	139	60	130
	6:00	70	85	165	8.5	16	200	0.4	140	60	130
	8:00	70	85	160	8.5	16	200	0.4	135	58	130
	10:00	70	84	160	8.5	16	200	0.4	140	70	130
	12:00	65	84	160	8.5	16	200	0.4	135	69	135
	14:00	68	84	160	8.5	16	200	0.4	130	68	132
	16:00	70	85	160	8.5	16	200	0.4	135	72	130
	18:00	67	84	160	8.5	16	200	0.4	133	66	133
	20:00	63	84	159	8.5	16	200	0.4	135	64	137
	22:00	63	84	158	8.5	16	200	0.4	132	63	137
	24:00	65	84	160	8.5	16	200	0.4	134	62	135
5/1/93	2:00	65	84	160	8.5	16	200	0.4	135	61	135
	4:00	65	84	160	8.5	16	200	0.4	140	62	135

IITRI OPERATING DATA

Date	Time	Inlet Air Flow (CFM)	Inlet Air Pres (psi)	Vapor Temp (F)	Suction (in Water)	Discharge (in Water)	Mixed Vapor Flow (CFM)	Mixed Vapor Press (psi)	Mixed Vapor Temp (F)	Ambient Temp (F)	Vapor Flow (SCFM)
	6:00	60	84	160	9	16	200	0.4	140	62	140
	8:00	60	84	156	8.5	16	200	0.4	130	63	140
	10:00	60	84	155	8.5	16	200	0.4	130	64	140
	12:00	60	84	160	8.5	16.5	200	0.4	131	73	140
	14:00	60	84	161	8.5	16	200	0.4	135	78	140
	16:00	60	84	163	8.5	16.5	200	0.4	135	82	140
	18:00	63	84	163	8.5	16	200	0.4	130	80	137
	20:00	63	84	158	8.5	16	200	0.4	125	77	137
	22:00	60	84	155	8	16	200	0.4	110	74	140
	24:00	60	84	153	8	16	200	0.4	110	70	140
5/2/93	2:00	60	84	152	8	16	200	0.4	109	70	140
	4:00	60	84	150	8.5	16	200	0.4	109	60	140
	6:00	60	84	149	8.5	16	200	0.4	109	60	140
	8:00	60	85	149	8.5	16	200	0.4	110	57	140
	10:00	60	85	149	8.5	16	200	0.4	115	68	140
	12:00	60	85	148	8.5	16	200	0.4	115	68	140
	14:00	63	84	150	8.5	16	200	0.4	120	74	137
	16:00	60	86	153	8.5	16	200	0.4	125	76	140
	18:00	60	86	155	8.5	16	200	0.4	120	74	140
	20:00	60	87	155	8.5	16	200	0.4	120	70	140
	22:00	60	85	150	8.5	16	200	0.4	120	70	140
	24:00	60	82	150	8.5	16	200	0.4	120	60	140
5/3/93	2:00	60	85	151	8.5	16	200	0.4	121	60	140
	4:00	60	85	150	8	16	200	0.4	120	59	140
	6:00	60	85	151	8	16	200	0.4	120	58	140
	8:00	60	85	150	8	16	200	0.4	120	62	140
	10:00	60	88	155	8	16	200	0.4	120	76	140
	12:00	60	89	160	8	16	200	0.4	125	80	140
	14:00	60	89	160	8	16	200	0.4	130	82	140
	16:00	80	90	163	8	16	200	0.4	130	82	120
	18:00	75	90	163	8	16	200	0.4	130	82	125
	20:00	80	89	160	8	15	200	0.4	125	76	120
	22:00	80	88	158	8	15	200	0.4	124	74	120
	24:00	80	86	150	8	15	200	0.4	125	64	120
5/4/93	2:00	80	87	152	8	15	200	0.4	125	64	120
	4:00	87	88	154	8	15	200	0.4	122	64	113
	6:00	86	87	155	8	15	200	0.4	128	64	114
	8:00	85	87	155	8	15	200	0.4	120	66	115
	10:00	85	87	155	8	15	200	0.4	120	67	115
	12:00	85	87	155	8	15	200	0.4	120	69	115
	14:00	85	87	157	8	16	200	0.4	125	73	115
	16:00	85	88	160	8	15.5	200	0.4	130	76	115
	18:00	84	88	160	8	16	200	0.4	130	78	116
	20:00	85	87	160	8	16	200	0.4	125	76	115
	22:00	85	86	155	8	16	200	0.4	125	75	115
	24:00	85	87	157	8	16	200	0.4	126	74	115
5/5/93	2:00	85	87	156	8	16	200	0.4	125	70	115
	4:00	85	87	155	8	16	200	0.4	130	66	115
	6:00	85	86	155	8	16	200	0.4	125	60	115
	8:00	85	87	155	8	15	200	0.4	125	60	115
	10:00	85	87	155	8	15	200	0.4	125	60	115
	12:00	90	87	157	8.5	16	200	0.4	130	63	110
	14:00	89	87	157	8.5	16	200	0.4	135	60	111
	16:00	89	87	157	8.5	16	200	0.4	137	60	111
	18:00	89	88	157	8.5	16	200	0.4	135	60	111

IITRI OPERATING DATA

Date	Time	Inlet Air Flow (CFM)	Inlet Air Pres (psi)	Vapor Temp (F)	Suction (in Water)	Discharge (in Water)	Mixed Vapor Flow (CFM)	Mixed Vapor Press (psi)	Mixed Vapor Temp (F)	Ambient Temp (F)	Vapor Flow (SCFM)
	20:00	89	88	157	8.5	16	200	0.4	135	60	111
	22:00	88	87	155	8.5	16	200	0.4	130		112
	24:00	88	87	156	8	16	200	0.4	130	60	112
5/6/93	2:00	88	86	155	8	16	200	0.4	127	59	112
	4:00	88	85	155	8	16	200	0.4	130	59	112
	6:00	87	86	160	8	16	200	0.4	135	60	113
	8:00	90	86	158	8	16	200	0.4	130	63	110
	10:00	85	87	161	8	15	200	0.4	130	68	115
	12:00	85	88	165	8	15	200	0.4	135	75	115
	14:00	90	87	164	8.5	16	200	0.4	135	77	110
	16:00	90	87	165	8	16	200	0.4	137	80	110
	18:00	90	87	164	8	16	200	0.4	137	80	110
	20:00	87	87	162	8	16	200	0.4	130	78	113
	22:00	87	87	162	8	16	200	0.4	130	78	113
	24:00	87	87	161	8	16	200	0.4	130	70	113
5/7/93	2:00	85	87	160	8	16	200	0.4	130	68	115
	4:00	85	86	160	8	16	200	0.4	130	68	115
	6:00	85	86	161	8	16	200	0.4	132	68	115
	8:00	85	86	160	8	16	200	0.4	132	69	115
	10:00	80	86	160	8	16	200	0.4	130	70	120
	12:00	75	86	162	8	16	200	0.4	127	79	125
	14:00	75	86	162	8	16	200	0.5	126	77	125
	16:00	75	86	162	8	15	200	0.5	125	69	125
	18:00	80	84	160	8	15	200	0.5	125	65	120
	20:00	80	86	160	8	15	200	0.4	125	65	120
	22:00	85	86	160	8	15	200	0.4	125	64	115
	24:00	85	86	160	8	15	200	0.4	130	62	115
5/8/93	2:00	85	87	160	8	15	200	0.4	125	62	115
	4:00	85	86	161	8	15	200	0.4	130	62	115
	6:00	85	86	158	8	15	200	0.4	130	62	115
	8:00	85	86	158	8	15	200	0.4	124	64	115
	10:00		86	156	8	15	200	0.5	124	68	200
	12:00		86	157	8	15	200	0.5	123	71	200
	14:00		86	159	8	15	200	0.5	123	73	200
	16:00		86	160	8	15	200	0.5	125	71	200
	18:00		86	159	8	15	200	0.4	125	69	200
	20:00		86	159	8	15	200	0.4	122	67	200
	22:00		86	160	8	15	200	0.4	125	67	200
	24:00		86	160	8	15	200	0.4	125	67	200
5/9/93	2:00		86	160	8	15	200	0.4	130	66	200
	4:00		86	157	8	15	200	0.4	130	64	200
	6:00		86	155	8	15	200	0.4	130	64	200
	8:00		86	157	8	15	200	0.4	121	65	200
	10:00		86	157	8	15	200	0.4	122	68	200
	12:00		86	159	8	15	200	0.4	124	70	200
	14:00		87	163	8	16	200	0.4	127	74	200
	16:00		87	164	8	16	200	0.4	127	77	200
	18:00		87	164	8	16	200	0.4	127	77	200
	20:00		87	163	8	16	200	0.4	125	73	200
	22:00		87	159	8	16	200	0.4	110	65	200
	24:00		86	155	8	15	200	0.4	115	58	200
5/10/93	2:00		87	155	8	15	200	0.4	120	56	200
	4:00		87	155	8	15	200	0.4	120	56	200
	6:00		86	152	8	15	200	0.4	120	56	200
	8:00		87	154	8	15	200	0.4	120	57	200

IITRI OPERATING DATA

Date	Time	Inlet Air Flow (CFM)	Inlet Air Pres (psi)	Vapor Temp (F)	Suction (in Water)	Discharge (in Water)	Mixed Vapor Flow (CFM)	Mixed Vapor Press (psi)	Mixed Vapor Temp (F)	Ambient Temp (F)	Vapor Flow (SCFM)
	10:00		88	156	8	15	210	0.4	121	64	210
	12:00	80	88	159	8	15	210	0.4	123	68	130
	14:00	85	89	163	8	15	210	0.4	125	71	125
	16:00	85	89	163	8	15	210	0.4	125	72	125
	18:00	80	90	165	8	15	210	0.4	127	74	130
	20:00	80	90	165	8	15	205	0.4	127	70	125
	22:00	80	88	160	8	15	205	0.4	127	68	125
	24:00	80	88	159	8	15	205	0.4	125	50	125
5/11/93	2:00	80	88	160	8	15	210	0.4	125	50	130
	4:00	82	88	160	8	15	210	0.4	125	52	128
	6:00	80	88	155	8	15	210	0.4	120	54	130
	8:40	75	87	156	8	15	210	0.4	120	65	135
	10:00	75	88	158	8	15	210	0.4	121	72	135
	12:00	75	88	160	8	15	210	0.4	123	79	135
	14:00	80	89	162	7	15	210	0.4	124	82	130
	16:00	60	90	162	7	15	210	0.4	125	84	150
	18:00	70	90	162	7	15	200	0.4	125	84	130
	20:00	80	90	163	7	15	200	0.4	125	78	120
	22:00	80	88	161	7	15	200	0.4	123	70	120
	24:00		87	157	7	15	200	0.4	120	66	200
5/12/93	2:00	80	87	159	7	15	200	0.4	122	64	120
	4:00	80	87	152	7.5	15	205	0.4	110	64	125
	6:00	81	87	155	7.5	15	205	0.4	115	65	124
	8:00	80	88	153	8	15	210	0.4	115	69	130
	12:45	80	89	160	8	15	210	0.4	118	82	130
	14:00	80	89	161	8	15	210	0.4	118	80	130
	16:00	75	90	160	7	15	210	0.4	120	81	135
	18:00	75	90	162	8	15	210	0.4	120	78	135
	20:00	80	88	160	8	15	210	0.4	120	76	130
	22:00	80	88	155	8	15	210	0.4	120	72	130
	24:00	80	88	154	8	15	210	0.4	122	70	130
5/13/93	2:00	80	88	155	7.5	15	210	0.4	120	62	130
	4:00	80	87	154	7.5	15	210	0.4	119	56	130
	6:00	80	87	155	7.5	15	210	0.4	120	56	130
	8:00	80	86	153	8	15	210	0.4	116	66	130
	10:00	75	84	158	8	15	210	0.4	119	78	135
	12:00	75	84	162	8	15	210	0.4	121	82	135
	14:00	75	85	165	8	15	210	0.4	121	80	135
	16:00	75	88	166	8	15	210	0.4	125	84	135
	18:00	70	88	166	8	15	210	0.4	125	84	140
	20:00	80	88	165	8	15	210	0.4	125	76	130
	22:00	80	87	163	8	15	210	0.4	120	70	130
	24:00	80	83	159	7.5	15	210	0.4	120	64	130
5/14/93	2:00	80	84	160	7.5	15	210	0.4	120	63	130
	4:00	80	84	155	7.5	15	205	0.4	115	62	125
	6:00	80	84	155	7.5	15	205	0.4	115	58	125
	8:00	80	84	155	7	15	210	0.4	116	73	130
	10:00	85	84	158	7	15	210	0.4	120	77	125
	12:00	80	86	164	8	15	210	0.4	121	86	130
	14:00	70	86	165	8	15	210	0.4	126	89	140
	16:00	70	87	165	8	15	210	0.4	128	89	140
	18:00	65	86	165	8	15	210	0.4	130	85	145
	20:00	80	85	163	8	15	210	0.4	125	80	130
	22:00	80	84	160	8	15	210	0.4	120	74	130
	24:00	90	84	157	8	15	210	0.4	110	69	120

IITRI OPERATING DATA

Date	Time	Inlet Air Flow (CFM)	Inlet Air Pres (psi)	Vapor Temp (F)	Suction (in Water)	Discharge (in Water)	Mixed Vapor Flow (CFM)	Mixed Vapor Press (psi)	Mixed Vapor Temp (F)	Ambient Temp (F)	Vapor Flow (SCFM)
5/15/93	2:00	90	84	156	8	15	210	0.4	110	64	120
	4:00	90	84	156	8	15	210	0.4	110	62	120
	6:00	90	84	156	8	15	210	0.4	110	60	120
	8:00	80	84	156	7	15	210	0.4	117	77	130
	10:00	75	85	160	7	15	210	0.4	120	87	135
	12:00	80	85	165	7	15	210	0.4	122	88	130
	14:00	80	86	165	7	15	210	0.4	127	91	130
	16:00	80	86	165	7	15	210	0.4	129	89	130
	18:00	70	87	165	7	15	210	0.4	130	88	140
	20:00	70	86	165	7	15	210	0.4	127	80	140
	22:00	85	84	155	7	15	210	0.4	125	76	125
	24:00	80	84	155	7	15	210	0.4	115	72	130
5/16/93	2:00	85	84	154	7	15	210	0.4	115	68	125
	4:00	85	84	155	7	15	210	0.4	115	65	125
	6:00	85	83	155	7	15	210	0.4	115	63	125
	8:00	80	83	155	7	15	210	0.4	115	68	130
	10:00	80	84	157	7	15	210	0.4	119	76	130
	12:00	80	85	161	7	15	210	0.4	121	83	130
	14:00	85	86	163	7	15	210	0.4	125	86	125
	16:00	85	86	165	7	15	210	0.4	125	88	125
	18:00	80	86	165	7	15	210	0.4	125	88	130
	20:00	80	84	160	7	15	210	0.4	120	80	130
	22:00	80	84	157	7	15	210	0.4	120	76	130
	24:00	80	84	155	7	15	210	0.4	120	70	130
5/17/93	2:00	80	85	158	7	15	210	0.4	120	68	130
	4:00	80	84	155	7	15	210	0.4	115	68	130
	6:00	80	84	154	7	15	210	0.4	118	70	130
	8:00	80	84	154	7	15	210	0.4	115	70	130
	10:00	80	85	155	7	15	210	0.4	118	73	130
	12:00	80	86	161	7	15	210	0.4	120	80	130
	14:00	85	88	165	7	15	210	0.4			125
	16:00	80	86	159	7	15	210	0.4	122	88	130
	18:00	80	87	160	7	15	210	0.4	125	85	130
	20:00	80	88	160	7	15	210	0.4	123	82	130
	22:00	83	84	155	7	15	210	0.4	120	76	127
	24:00	80	84	154	7	15	210	0.4	115	73	130
5/18/93	2:00	80	84	156	7	15	210	0.4	117	72	130
	4:00	80	83	154	7	14	210	0.4	113	64	130
	6:00	80	84	154	7	15	210	0.4	115	63	130
	8:00	80	84	157	7	15	210	0.4	120	67	130
	10:00	85	84	160	7	15	210	0.4	120	65	125
	12:00	80	84	150	7	15	210	0.4	115	65	130
	14:00	80	85	155	7	15	210	0.4	120	78	130
	16:00	80	85	155	7	15	210	0.4	120	82	130
	18:00	80	86	165	7	15	210	0.4	125	80	130
	20:00	80	86	161	7	15	210	0.4	120	76	130
	22:00	80	86	160	7	15	210	0.4	115	76	130
	24:00	80	85	155	7	15	210	0.4	115	65	130
5/19/93	2:00	80	84	150	7	15	210	0.4	113	62	130
	4:00	80	84	150	7	15	210	0.4	111	60	130
	6:00	80	85	149	7	15	210	0.4	110	57	130
	8:00	80	85	150	7	15	210	0.4	115	70	130
	10:00	80	56	150	7	15	180	0.4	115	70	100
	12:00	80	46	155	7	14	160	0.4	120	70	80
	14:00	80	46	160	7	15	160	0.4	120	76	80

IITRI OPERATING DATA

Date	Time	Inlet Air Flow (CFM)	Inlet Air Pres (psi)	Vapor Temp (F)	Suction (in Water)	Discharge (in Water)	Mixed Vapor Flow (CFM)	Mixed Vapor Press (psi)	Mixed Vapor Temp (F)	Ambient Temp (F)	Vapor Flow (SCFM)
	16:00	55	45	160	7	14	160	0.4	115	74	105
	18:00	60	46	160	7	14	160	0.4	125	74	100
	20:00	60	46	155	7	15	160	0.4	120	70	100
	22:00	60	45	152	7	14	160	0.4	110	64	100
	24:00	65	46	151	7	14	160	0.4	114	59	95
5/20/93	2:00	65	46	149	7	14	160	0.4	114	55	95
	4:00	70	46	148	7	14	160	0.4	112	53	90
	6:00	65	46	147	7	14	160	0.4	112	52	95
	8:00	60	46	148	7	14	155	0.4	110	60	95
	10:00	60	45	150	7	14	155	0.4	110	63	95
	12:00	60	46	152	7	14	157	0.4	115	70	97
	14:00	55	46	155	7	14	160	0.4	115	76	105
	16:00	55	46	154	7	14	160	0.4	115	76	105
	18:00	56	46	155	7	14	160	0.4	115	74	104
	20:00	60	46	152	7	14	160	0.4	115	69	100
	22:00	55	44	148	7	14	160	0.4	110	66	105
	24:00	55	44	144	7	14	160	0.4	108	61	105
5/21/93	2:00	55	44	144	7	13	160	0.4	108	58	105
	4:00	55	44	144	7	13	160	0.4	108	54	105
	6:00	55	44	144	7	14	160	0.4	107	53	105
	8:00	55	44	144	7	14	160	0.4	106	56	105
	10:00	55	44	145	7	14	160	0.4	110	69	105
	12:00	55	44	148	7	14	160	0.4	112	76	105
	14:00	55	45	151	7	15	160	0.4	115	76	105
	16:00	60	46	152	7	15	160	0.4	115	76	100
	18:00	60	46	150	7	14	160	0.4	120	76	100
	20:00	55	46	147	7	14	160	0.4	115	74	105
	22:00	55	46	145	7	14	160	0.4	115	61	105
	24:00	60	45	142	7	13	160	0.4	104	61	100
5/22/93	2:00	60	45	142	7	13	160	0.4	105	60	100
	4:00	60	45	142	7	13	160	0.4	105	60	100
	6:00	60	46	142	7	13	160	0.4	105	60	100
	8:00	60	46	144	7	13	160	0.4	105	62	100
	10:00	60	46	145	7	13	160	0.4	110	62	100
	12:00	60	46	145	7	13	160	0.4	110	68	100
	14:00	60	46	147	7	13	160	0.4	112	69	100
	16:00	60	46	145	7	14	150	0.4	110	65	90
	18:00	60	49	145	8	15	160	0.4	110	65	100
	20:00	60	50	150	8	14	160	0.5	110	61	100
	22:00	60	49	150	8	15	160	0.5	120	62	100
	24:00	55	48	149	8	14	160	0.5	119	63	105
5/23/93	2:00	60	48	149	8	14	160	0.4	120	63	100
	4:00	60	48	151	8	14	160	0.4	120	63	100
	6:19	55	48	147	8	14	160	0.4	119	54	105
	8:15	60	48	145	8	14	160	0.4	120	54	100
	10:00	60	48	150	8	14	160	0.4	125	57	100
	12:00	60	48	150	8	14	160	0.4	120	57	100
	14:00	60	48	146	8	14	160	0.4	120	57	100
	16:00	60	48	145	8	14	160	0.4	121	57	100
	18:00	60	48	152	8	14	160	0.4	125	56	100
	20:00	55	49	155	8	14	170	0.4	125	60	115
	22:00	55	50	155	8	14	165	0.4	125	60	110
	24:00	55	48	154	8	14	170	0.4	122	57	115
5/24/93	2:00	60	48	153	8	14	170	0.4	122	55	110
	4:00	60	48	152	8	14	170	0.4	120	54	110

IITRI OPERATING DATA

Date	Time	Inlet Air Flow (CFM)	Inlet Air Pres (psi)	Vapor Temp (F)	Suction (in Water)	Discharge (in Water)	Mixed Vapor Flow (CFM)	Mixed Vapor Press (psi)	Mixed Vapor Temp (F)	Ambient Temp (F)	Vapor Flow (SCFM)
	6:00	60	48	152	8	14	170	0.4	120	54	110
	8:00	60	48	152	8	14	170	0.4	120	60	110
	10:00	60	46	155	8	14	180	0.4	125	65	120
	12:00	80	92	157	8	15	210	0.4	125	68	130
	14:00	75	90	157	8	15	210	0.4	125		135
	16:00	75	90	158	8	15	210	0.4	120	70	135
	18:00	78	91	158	8	15	211	0.4	120	68	133
	20:00	75	92	155	8	15	210	0.4	116	67	135
	22:00	80	91	154	8	15	210	0.4	120	62	130
	24:00	75	92	153	8	15	220	0.4	115	60	145
5/25/93	2:00	80	93	153	8	15	230	0.4	115	56	150
	4:00	80	93	151	8	15	230	0.4	114	55	150
	6:00	80	93	151	8	15	230	0.4	114	54	150
	8:00	80	92	152	8	15	230	0.4	115	66	150
	10:00	75	92	154	8	15	230	0.4	120	68	155
	12:00	80	92	155	8	15	230	0.4	122	70	150
	14:00	80	94	155	8	15	220	0.4	120	74	140
	16:00	80	85	156	8	15	210	0.4	120	75	130
	18:00	80	84	154	8	15	210	0.4	120	76	130
	20:00	80	84	153	8	15	210	0.4	115	70	130
	22:00	75	84	150	8	15	210	0.4	115	66	135
	24:00	75	84	149	8	15	220	0.4	113	62	145
5/26/93	2:00	75	84	149	8	15	220	0.4	113	61	145
	4:00	75	84	15	8	15	220	0.4	114	60	145
	6:00	75	84	149	8	15	220	0.4	113	60	145
	8:00	75	86	150	8	15	220	0.4	115	65	145
	10:00	75	86	151	8	15	220	0.4	115	68	145
	12:00	75	86	151	8	16	220	0.4	117	70	145
	14:00	75	86	155	8	16	220	0.4	117	72	145
	16:00	75	86	155	8	16	220	0.4	116	74	145
	18:00	75	86	152	8	16	220	0.4	115	72	145
	20:00	70	86	150	8	16	220	0.4	115	68	150
	22:00	75	86	150	8	16	220	0.4	113		145
	24:00	75	84	148	8	15	220	0.4	111	63	145
5/27/93	2:00	75	84	148	8	15	220	0.4	110	61	145
	4:00	75	85	147	8	15	220	0.4	110	59	145
	6:00	75	86	147	8	15	220	0.4	110	59	145
	8:00	75	86	150	8	15	220	0.4	112	62	145
	10:00	75	86	150	8	15	220	0.4	115	64	145
	12:00	75	87	155	8	16	220	0.4	115	66	145
	14:00	75	87	155	8	16	220	0.4	120		145
	16:00	75	88	154	8	16	220	0.4	118	76	145
	18:00	72	88	156	8	16	220	0.4	118	75	148
	20:00	75	85	150	8	15	215	0.4	110	72	140
	22:00	75	84	150	8	15	220	0.4	112	65	145
	24:00	75	85	147	8	15	220	0.4	108	63	145
5/28/93	2:00	75	86	147	8	15	220	0.4	107	61	145
	4:00	75	85	147	8	15	220	0.4	106	61	145
	6:00	75	85	147	8	15	220	0.4	106	60	145
	8:00	70	85	148	8	15	210	0.4	105	60	140
	10:00	70	85	150	8	15	210	0.4	108	67	140
	12:00	75	87	156	8	16	215	0.4	115	72	140
	14:00	75	86	159	8	16	210	0.4	118	76	135
	16:00	75	86	150	8	15	210	0.4	112	78	135
	18:00	75	85	150	8	15	210	0.4	111	78	135

IITRI OPERATING DATA

Date	Time	Inlet Air Flow (CFM)	Inlet Air Pres (psi)	Vapor Temp (F)	Suction (in Water)	Discharge (in Water)	Mixed Vapor Flow (CFM)	Mixed Vapor Press (psi)	Mixed Vapor Temp (F)	Ambient Temp (F)	Vapor Flow (SCFM)
	20:00	75	86	150	8	16	220	0.5	115	72	145
	22:00	70	86	150	8	15	220	0.4	115	70	150
	24:00	75	86	150	8	15	220	0.4	113	60	145
5/29/93	2:00	75	86	150	8	15	220	0.4	110	60	145
	4:00	75	85	150	8	15	220	0.4	108	60	145
	6:00	75	84	150	8	15	220	0.4	108	60	145
	8:00	75	84	150	8	15	220	0.4	108	62	145
	10:00	75	85	155	8	16	215	0.5	110	69	140
	12:00	75	86	157	8	16	220	0.4	112	72	145
	14:00	70	86	160	8	16	220	0.4	120	74	150
	16:00	75	86	160	8	16	220	0.4	120	80	145
	18:00	75	86	160	8	16	220	0.4	122	76	145
	20:00	75	86	157	8	155	220	0.5	120	80	145
	22:00	70	84	155	8	15.5	220	0.5	120	76	150
	24:00	75	84	154	8	15	220	0.4	118	74	145
5/30/93	2:00	75	84	152	8	15	220	0.4	115	72	145
	4:00	75	82	152	8	15	220	0.4	113	68	145
	6:00	75	84	150	8	15	220	0.4	110	64	145
	8:00	75	84	150	8	15	220	0.4	110	65	145
	10:00	75	86	155	8	16	220	0.4	110	67	145
	12:00	75	86	158	8	16	220	0.4	114	70	145
	14:00	75	87	165	8	16	220	0.4	130	77	145
	16:00	75	86	165	8	16	220	0.4	135	82	145
	18:00	75	86	165	8	16	220	0.4	135	76	145
	20:00	75	84	160	8	16	220	0.4	120	72	145
	22:00	75	84	160	8	16	220	0.4	120	70	145
	24:00	75	84	158	8	16	220	0.4	120	68	145
5/31/93	2:00	75	86	155	8	16	220	0.4	115	65	145
	4:00	75	86	152	8	16	220	0.4	113	60	145
	6:00	75	86	150	8	16	220	0.4	110	60	145
	8:00	75	86	155	8	16	220	0.4	110	64	145
	10:00	75	87	160	8	16	220	0.4	110	74	145
	12:00	60	46	164	8	16	185	0.4	125	82	125
	14:00	60	46	165	8	16	190	0.4	130	83	130
	16:00	60	46	165	8	16	190	0.4	130	85	130
	18:00	60	46	164	8	16	190	0.4	130	82	130
	20:00	60	45	161	8	16	190	0.4	115	76	130
	22:00	60	46	161	8	16	190	0.4	117	68	130
	24:00	60	46	155	8	16	190	0.4	115	66	130
6/1/93	2:00	60	46	155	8	16	185	0.4	113	64	125
	4:00	60	46	155	8	16	190	0.4	110	62	130
	6:00	60	46	150	7	16	190	0.4	105	60	130
	8:00	60	46	151	7	16	190	0.4	110	64	130
	10:00	60	44	159	7	16	190	0.4	115	72	130
	12:00	60	44	160	8	16	190	0.4	118	76	130
	14:00	70	44	165	8	15	190	0.4	125	76	120
	16:00	70	46	165	8	15	180	0.5	124	78	110
	18:00	70	44	164	8	15	180	0.5	117	76	110
	20:00	70	44	160	7	14	170	0.5	113	73	100
	22:00	60	44	158	7	14	170	0.5	112	69	110
	24:00	60	44	155	7	15	170	0.5	112	67	110
6/2/93	2:00	60	45	154	7	15	170	0.4	110	65	110
	4:00	70	44	152	7	15	170	0.4	108	62	100
	6:00	70	44	152	7	15	170	0.4	105	60	100
	8:00	70	44	154	7	15	185	0.4	110	62	115

IITRI OPERATING DATA

Date	Time	Inlet Air Flow (CFM)	Inlet Air Pres (psi)	Vapor Temp (F)	Suction (in Water)	Discharge (in Water)	Mixed Vapor Flow (CFM)	Mixed Vapor Press (psi)	Mixed Vapor Temp (F)	Ambient Temp (F)	Vapor Flow (SCFM)
	10:00	70	44	155	7	15	190	0.4	110	74	120
	12:00	70	45	160	7.5	15	190	0.4	120	80	120
	14:00	70	45	163	7.5	15	190	0.4	130		120
	16:00	70	45	164	7	15	180	0.5	130	83	110
	18:00	70	45	164	7	14	180	0.5	125	84	110
	20:00	70	45	162	7	14	180	0.4	114	79	110
	22:00	70	44	137	7	14	180	0.4	110	73	110
	24:00	70	44	155	7	14	180	0.4	110	70	110
6/3/93	2:00	70	44	153	7	14	180	0.4	110	68	110
	4:00	70	44	151	7	14	180	0.4	108	66	110
	6:00	70	45	150	7	14	170	0.4	105	64	100
	8:00	70	45	155	7	14	180	0.4	105	68	110
	10:00	70	45	155	7	14	185	0.4	110	72	115
	12:00	70	44	162	7	15	200	0.4	128	80	130
	14:00	70	44	165	7	15	200	0.4	130	84	130
	16:00	75	86	165	8	16	210	0.4	132	85	135
6/4/93	8:00	70	88	155	8	15	240	0.4	100	69	170
	9:00	70	88	153	8	15	240	0.4	105	73	170
6/5/93	9:00	70	88	145	8	15	240	0.4	100	72	170
6/6/93	8:30	70	88	145	8	15	240	0.4	100	71	170
6/7/93	9:26	70	88	145	8	16	240	0.4	103	69	170
6/8/93	9:00	70	84	144	8	15	240	0.4	100	70	170
6/9/93	8:45	70	84	144	7.5	15	240	0.4	100	74	170
6/10/93	8:51	70	84	141	7.5	15	240	0.4	100	70	170
6/11/93	8:10	70	84	143	7	15	240	0.4	96	76	170
6/12/93	8:05	70	84	143	7.5	15	240	0.4	97	74	170
6/13/93	8:00	70	84	147	7.5	16	240	0.4	99	74	170
6/14/93	7:25	70	84	144	7.5	16	240	0.4	95	71	170
6/15/93	7:35	70	85	145	8	16	240	0.4	105	72	170
6/16/93	9:45	70	87	156	7.5	16	250	0.3	112	82	180
6/17/93	9:00	70	86	148	7.5	16	240	0.4	96	73	170
6/18/93	9:10	76	84	142	7.5	16	230	0.4	98	73	154
6/19/93	10:41	70	84	144	7.5	16	240	0.4	100	78	170
6/20/93	9:05	70	84	141	7.5	16	220	0.5	92	72	150
6/21/93	8:05	70	84	141	7.5	16	230	0.5	93	74	160
6/22/93	7:10	70	84	142	7.5	16	230	0.5	95	73	160
6/23/93	8:15	70	84	140	7.5	16	220	0.4	98	75	150
6/24/93	7:35	70	84	140	7.5	16	230	0.5	94	74	160
6/25/93	7:25	70	84	138	7.5	16	230	0.5	90	77	160
6/26/93	7:35	70	84	138	7.5	16	230	0.4	91	69	160
6/27/93	9:35	70	84	140	7.5	16	230	0.4	100	80	160
6/28/93	7:35	70	84	137	7.5	16	230	0.4	94	76	160
6/29/93	7:25	70	84	138	7.5	16	230	0.4	93	79	160
6/30/93	8:15	50	42	136	6.5	13	150	0.6	96	80	100
7/1/93	8:10	60	44	135	7	15	170	0.5	98	80	110
7/2/93	7:12	60	44	136	7	15	170	0.4	98	79	110
7/3/93	11:15	60	44	145	7	15	170	0.5	102	90	110
7/4/93	11:20	60	42	140	7	15	170	0.4	99	80	110
7/5/93	10:10	55	44	137	14	20	170	0.4	100	85	115
7/6/93	8:10	60	44	140	13	19	170	0.5	99	75	110
7/7/93	8:00	55	42	135	13	20	170	0.4	99	75	115
7/8/93	8:10	55	44	135	13	19	170	0.4	99	80	115
7/9/93	6:30	55	44	135	13	19	170	0.4	99	77	115
7/10/93	9:45	55	44	135	13	20	170	0.4	99	90	115
7/11/93	11:30	55	44	135	13	20	170	0.4	99	95	115

IITRI OPERATING DATA

Date	Time	Inlet Air Flow (CFM)	Inlet Air Pres (psi)	Vapor Temp (F)	Suction (in Water)	Discharge (in Water)	Mixed Vapor Flow (CFM)	Mixed Vapor Press (psi)	Mixed Vapor Temp (F)	Ambient Temp (F)	Vapor Flow (SCFM)
7/12/93	8:00	55	44	135	13	19	170	0.4	99	85	115
7/13/93	7:45			80					78		
7/14/93	8:14			79					76		
7/15/93	6:25			78					79		
7/16/93	8:00			79					79		
7/17/93	8:00			81					79		
7/21/93	8:10	30	0.3	127	5	4	100	0.4	94		70
7/22/93	8:15	30	3	129	4	4	95	0.4	93		65
7/23/93	7:45	30	3.5	126	4	4	95	0.4	90		65
7/24/93	9:10	30	5	128	4	4	95	0.4	96		65
7/25/93	9:15	30	4	127	4	4	75	0.4	97		45
7/26/93	8:30	30	6	125	4	4	75	0.4	89		45
7/27/93	7:55	30	6	126	4	4	75	0.4	90		45
7/28/93	7:45	30	6	122	4	4	75	0.4	90		45
7/29/93	8:00	30	6	131	4	4	60	0.4	94		30
7/30/93	8:05	30	8	131	4	4	75	0.4	93		45
7/31/93	9:30	30	8	132	4	4	75	0.4	95		45
8/1/93	9:13	30	7	131	4	4	70	0.4	94		40
8/2/93	7:55	30	7	128	4	4	75	0.4	89	78	45

APPENDIX E

Science Applications International Corporation
An Employee-Owned Company

JUN 1993 RECEIVED OAK RIDGE OFFICE

May 27, 1993

Mr. Cliff Blanchard
Halliburton NUS Environmental Corporation
800 Oak Ridge Turnpike
Jackson Plaza, C-200
Oak Ridge, Tennessee 37830

RE: EPA Contract No. 68-C0-0048, WA 0-44
SAIC Project No. 01-0832-07-2249-014

Dear Mr. Blanchard:

Please find the enclosed four tables summarizing grain size distribution within the test plot. ASTM D422 was the procedure used for mechanical sieving, and specific gravity tests were conducted following procedure ASTM D845-83.

Tables 1-3 show the particle size distribution summary along the three plan-view cross sections A1-A8, TW1-B4, and C1-C8, respectively. Table 4 presents particle size data on selected samples which further subdivide the fines into silt and clay percentages, and present specific gravities. As a convenience, the particle sizes shown in Tables 1-3 are listed in order of descending percentage of the total, the dominant size listed first.

If you have any questions regarding this information, please do not hesitate to call me at (513) 723-2600, extension 2610.

Sincerely,

SCIENCE APPLICATIONS INTERNATIONAL CORPORATION

J. Rawe

Jim Rawe
Work Assignment Manager

Encls.

b3.blnchrd4.ltr

635 West Seventh Street, Suite 403, Cincinnati, Ohio 45203 • (513) 723-2600 • FAX: (513) 723-2605
Other SAIC Offices: Albuquerque, Boston, Colorado Springs, Dayton, Huntsville, Las Vegas, Los Angeles, McLean, Oak Ridge, Orlando, Palo Alto, Seattle, Tucson

TABLE 1. PARTICLE SIZE DISTRIBUTION - CROSS SECTION A1-A8

Sample Interval Depth BLS (ft)	Particle Size Distribution by Soil Boring (% by weight)[a]							
	A1	A2	A3	A4	A5	A6	A7	A8
0 - 2				S-50[b] G-32 F-18				
2 - 4			G-45[b] S-36 F-19					
4 - 6	S-48[c] G-28 F-24							
6 - 8								
8 - 10							S-57[b] G-43	
10 - 12								
12 - 14		S-49[c] F-32 G-19					S-72[c] G-20 F-8	
14 - 16								F-49[b] G-26 S-25
16 - 18			S-53[c] F-33 G-14					
18 - 20						G-74[b] S-19 F-7		
20 - 22				G-63[b] F-21 S-16				
22 - 24					G-78[b] S-19 F-3			
24 - 26								
26 - 28								
28 - 30								G-58[b] S-25 F-17
30 - 32								
32 - 34								
34 - 36								

Notes:

a Percentages have been rounded to whole numbers
b Results are from one test
c Results are the average of two tests, one from a sample sleeve and the other from a bagged sample
— Approximate start of gravel zone.
___ Navarro Clay

G = Gravel
S = Sand
F = Fines (silt and clay)

TABLE 2. PARTICLE SIZE DISTRIBUTION - CROSS SECTION TW1-B4

Sample Interval Depth BLS (ft)	Particle Size Distribution by Soil Boring (% by weight)[a]					
	TW1	TW2	B1	B2	B3	B4
0 - 2			S-39[d] F-36 G-35			
2 - 4					S-40[b] G-38 F-22	
4 - 6	F-29 G-34 S-27	F-41 S-30 G-29		F-56[b] S-38 G-6		
6 - 8						
8 - 10				G-67[b] S-25 F-8		
10 - 12					G-50[b] S-26 F-24	
12 - 14			S-54[c] F-27 G-19	F-78[d] S-18 G-4		
14 - 16	S-51[b] F-35 G-14	F-41[b] S-33 G-19				
16 - 18						S-51[b] F-27 G-22
18 - 20						
20 - 22						G-37[b] F-35 S-28
22 - 24						G-86[b] F-10 S-4
24 - 26		G-92[b] S-6 F-2				
26 - 28			G-93[b] S-6 F-1			
28 - 30						
30 - 32						
32 - 34						
34 - 36		F-75[b,e] S-17 G-8				

Notes:

a. Percentages have been rounded to whole numbers

b Results are from one test

c Results are the average of two tests, one from a sample sleeve and the other from a bagged sample.

d Results are the average of samples from two separate sleeves and one bag sample.

e The 75% includes 51% silt and clay and 24% of unacccountable solids that did not settle out of suspension during hydrometer testing.

— Approximate start of gravel zone.

Navarro Clay

G = Gravel

S = Sand

F = Fines (silt and clay)

TABLE 3. PARTICLE SIZE DISTRIBUTION - CROSS SECTION C1-C8

Sample Interval Depth BLS (ft)	Particle Size Distribution by Soil Boring (% by weight)[a]							
	C1	C2	C3	TW7	C5	C6	C7	C8
0 - 2			F-49[c] G-30 S-21					
2 - 4						S-46[c] F-27 G-27		
4 - 6				G-40[b] S-34 F-26			S-45[c] G-32 F-23	G-48[c] S-34 F-18
6 - 8		S-47[c] F-28 G-25						
8 - 10							S-43[b] G-43 F-14	
10 - 12					G-41[b] S-34 F-25			
12 - 14								
14 - 16				G-42[b] S-36 F-22				S-44[c] G-30 F-26
16 - 18								
18 - 20			S-60[c] F-36 G-4			G-64[b] S-22 F-14		
20 - 22								
22 - 24			G-79[b] S-15 F-6					G-86[b] S-10 F-4
24 - 26				G-72[b] S-19 F-9		G-64[b] S-24 F-12		
26 - 28								
28 - 30								
30 - 32								
32 - 34								
34 - 36								

Notes:

a Percentages have been rounded to whole numbers

b Results are from one test

c Results are the average of two tests, one from a sample sleeve and the other from a bagged sample

--- Approximate start of gravel zone.

— Navarro Clay

G = Gravel

S = Sand

F = Silt clay

TABLE 4. Particle Size Distribution and Specific Gravities of Selected Tests Samples

Boring No.	Sample Interval - BLS (ft.)	PARTICLE SIZE (% by weight)[a]				Specific Gravity
		Gravel	Sand	Silt	Clay	
A3	2-4	45	36	19		2.51
A4	20-22	74	17	5	4	2.55
A8	14-16	26	25	31	18	2.43
B1	0-2	48	30	13	9	2.42
B2	12-14	34[b]	17[b]	20[b]	29[b]	2.32
B3	10-12	50	26	11	13	2.41
B4	20-22	37	28	17	18	2.53
C3	0-2	30	21	22	27	2.52
C3	22-24	79	15	3	3	2.62
C5	10-12	41	34	15	10	2.54
TW1	4-6	34	26	24	16	2.49
TW2	4-6	29	30	24	17	2.51
TW2	14-16	19	33	26	22	2.24
TW3	35-36	8	17	75 includ. colloids		2.34

a Percentages have been rounded off to whole numbers and are adjusted where rounding off did not result in a sum of 100%.

b Percentages are the average of one sleeve sample and one bagged sample.

APPENDIX F

Table A.7. - Soil Vapor Analytical Summary IITRI Demonstration

Chemical (mg/m3)	TPH	Benzene	Chloro-Benzene	Ethyl benzene	Toluene	Xylene total	Vinyl Chloride	PCE	Acetone	2-Butanone	Vinyl Acetate
Date											
3/30/93	190.00	1.15	5.00	0.14	0.39	0.20	0.23				2.90
3/30/93	220.00	0.37	4.80	0.09	0.79	0.14	0.29				5.50
3/31/93	250.00	2.80		0.18		0.19	0.10	0.02			2.50
4/1/93	2.50	0.04	2.80	0.02		0.10	0.01				0.02
4/2/93	1.00	2.20	8.50	0.29	0.55	0.38	0.04	1.20	0.26		1.80
4/3/93	210.00	0.65	7.00	0.22	0.50	0.02	0.02	0.60	0.13		1.90
4/3/93		0.93	8.00	0.22	0.46	0.21	0.01	0.61			4.10
4/4/93	100.00	0.98	7.30	0.22	0.61	0.30	0.02	0.98			2.70
4/4/93	220.00	1.10	3.00	0.24	0.70	0.22	0.02	1.20			2.10
4/5/93	1.00		4.20	0.15	0.28	0.19	0.02	0.60	0.13		0.90
4/5/93		0.02	2.90	0.02	0.02	0.05		0.02	0.04		
4/6/93	5.00		0.05								
4/6/93		0.04	1.50		0.01	0.10		0.02	0.04		
4/7/93	15.00	0.40	0.66		0.01						0.24
4/8/93	1.80	0.03	1.50			0.10				0.08	0.31
4/8/93	0.60	0.16	0.85		0.02						0.09
4/9/93	6.10	0.07	3.60	0.04	0.03	0.05		0.10			0.02
4/9/93		0.75	14.00	0.35	0.04	0.60		0.29			5.00
4/10/93	1.10	0.01	0.09						0.07		0.01
4/10/93		0.11	0.55		0.02					0.26	0.13
4/11/93	34.00	0.90	0.08	0.09				0.08		0.02	3.30
4/12/93	1.30	0.07								0.47	0.18
4/12/93		0.33	7.50		0.05	0.21		0.07	7.50	1.70	0.46
4/13/93	11.00	0.42	2.40		0.05			0.03		4.00	1.10
4/14/93	0.01										
4/14/93	0.13										
4/15/93	0.02										
4/16/93	0.06										
4/16/93					0.04						
4/17/93	0.16				0.03	0.02					
4/18/93					0.01						
4/18/93	0.02				0.02	0.01					
4/19/93	0.05							0.02			
4/19/93					0.01	0.01			0.07		
4/20/93	0.08	0.01			0.02	0.01			0.02		
4/20/93					0.01						
4/21/93	0.09										
4/22/93	0.09										
4/23/93	0.02										
4/24/93	0.08										
4/25/93	0.80										0.01
4/26/93	0.09										
4/26/93					0.01	0.01					
4/27/93	0.10										
4/28/93	0.14										
4/29/93	0.05										
4/30/93	0.12	0.01			0.05						
5/1/93	0.11				0.01						
5/2/93	0.07										
5/3/93	0.02	0.01			0.03	0.02					
5/3/93	0.04	0.16	0.05	0.02	0.11						
5/4/93		0.01			0.01	0.01					
5/6/93	6.30	0.16	0.08		0.12	0.02		0.06			
5/7/93		0.05			0.04				0.47		
5/7/93	2.70	0.64	8.30	0.39	0.74	0.60	0.64	0.39	2.40	1.70	

Table A.7. - Soil Vapor Analytical Summary
IITRI Demonstration

Chemical (mg/m3)	TPH	Benzene	Chloro-Benzene	Ethyl benzene	Toluene	Xylene total	Vinyl Chloride	PCE	Acetone	2-Butanone	Vinyl Acetate
5/8/93	0.02		0.01						0.36		
5/9/93	7.00										
5/9/93	0.04		0.03		0.01						
5/10/93	0.91	0.08	0.09	0.05	0.09					0.01	
5/11/93	7.10										
5/11/93	4.90										
5/12/93	45.00	0.19	0.12		0.07			0.01	32.00		0.50
5/14/93	98.00	3.20	3.60		2.30					13.00	
5/15/93	10.00	0.69			0.21				20.00		0.78
5/16/93	0.72	0.05			0.02				4.60		0.09
5/17/93	10.00	0.44			0.20						0.62
5/18/93	57.00	2.70	0.50	0.31	1.10	0.04	21.00		4.80	0.10	1.60
5/20/93	0.12	0.01								0.01	
5/21/93	0.18				0.03	0.02		0.01	0.01	0.01	
5/22/93	0.13	0.03	0.07	0.01	0.01				26.00	0.47	0.11
5/23/93	0.12										
5/24/93	93.00	3.90	0.05	0.05	3.40	0.17		0.06	19.00	0.07	0.09
5/25/93	0.35	0.02	0.01		0.02	0.01			0.01		
5/26/93	2.00	0.25	0.06	0.02	0.24	0.11				0.03	0.10
5/27/93	87.00	2.30	0.60	0.10	2.40	0.30		0.08			0.75
5/28/93	0.58	0.05	0.01		0.02				0.01	0.01	
5/29/93	0.12		0.01						0.01		
6/1/93	0.34		0.01		0.02					0.01	
6/2/93	0.10								0.06		
6/3/93	0.17	0.01	0.14		0.03		0.01		0.07	0.02	
6/4/93	0.02	0.02	0.03		0.01			0.03	0.07	0.03	
6/5/93	0.12	0.01	0.03	0.08	0.04	0.05				0.01	
6/6/93	4.20	0.37			0.01				0.90	0.09	0.27
6/7/93	0.02		0.01						0.01		
6/8/93	0.09			0.06	0.19	0.02					
6/9/93	0.06									0.02	0.05
6/10/93	ND									0.22	0.06
6/12/93	ND				0.19					0.13	
6/14/93	ND				0.02				0.22	0.30	0.26
6/16/93	0.04								0.05	0.26	0.01
6/18/93	0.56									0.05	0.39
6/20/93	0.19									0.02	
6/22/93	0.28										

APPENDIX G

DEWATERING SYSTEM

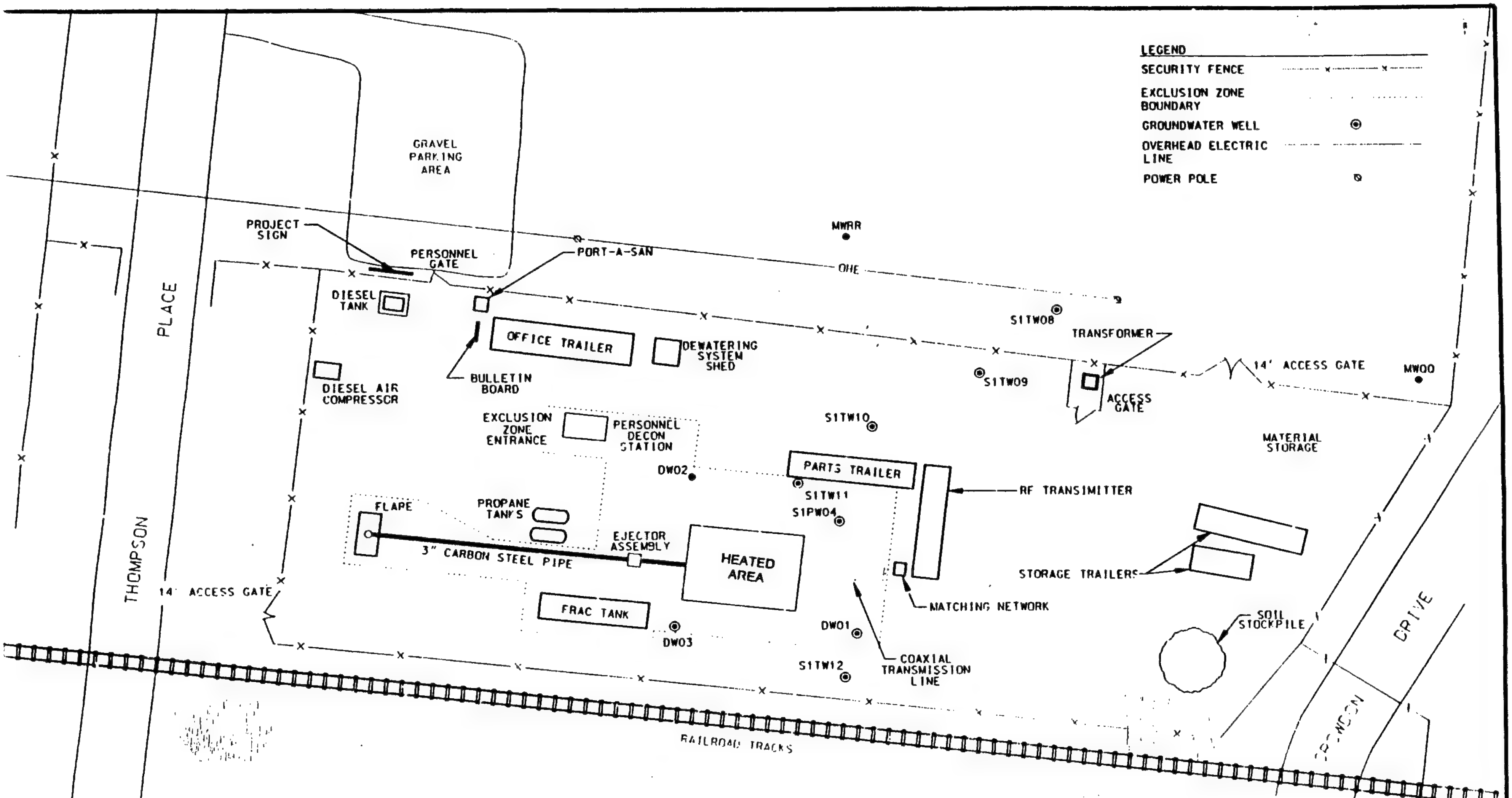
I. INTRODUCTION

The IITRI demonstration began in January 1993 with site preparation and the installation of a dewatering system around the demonstration area at Site S-1. The dewatering system was necessary to keep groundwater levels 5 feet below the bottom tip of the excitor electrodes. Initial water levels in January 1993 indicated the water table at approximately 22.4 feet below the surface. The top of the water table needed to be drawn down to a depth of approximately 24 feet or more below the surface. The dewatering system consisted of four dewatering wells six inches in diameter. One existing well (S1PW04) and three newly installed wells (DW01, DW02, and DW03) were used (Figure G.-1).

II. INSTALLATION

Installation of the three new dewatering wells was completed on January 28, 1993. DW01 was drilled to a depth of 42.5 feet and set at 39.8 feet. DW02 was drilled to a depth of 40 feet and set at 38 feet. DW03 was drilled to a depth of 35 feet and set at 35 feet. These dewatering wells were installed in a 14-inch diameter borehole with 20 feet of PVC screen 6 inches in diameter and a sump at the bottom. A sandpack was added and a bentonite seal was installed above the sandpack. Well S1PW04 had been installed in 1991 during a previous investigation to a depth of 38.9 feet with 14.5 feet of 6-inch diameter PVC screen. All dewatering wells were developed by using a surge block and a pump to remove suspended solids.

After well development the dewatering system was installed. The dewatering system consisted of ejectors in the wells, air lines from the electric air compressor and control panel located in a shed adjacent to the site office trailer, water lines leading from the wells to a "Frac" or storage tank located along the east side of the demonstration site. The dewatering system was installed during the end of January and the first part of February (see Figure 2).



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PROJECT SIGN
PERSONNEL GATE
PORT-A-SAN
OHE
MWRR
DIESEL TANK
DIESEL AIR COMPRESSOR
OFFICE TRAILER
BULLETIN BOARD
DEWATERING SYSTEM SHED
EXCLUSION ZONE ENTRANCE
PERSONNEL DECON STATION
DW02
FLARE
PROPANE TANKS
3" CARBON STEEL PIPE
EJECTOR ASSEMBLY
HEATED AREA
FRAC TANK
DW03
14' ACCESS GATE
RAILROAD TRACKS
PARTS TRAILER
S1TW11
S1PW04
S1TW10
DW01
S1TW12
COAXIAL TRANSMISSION LINE
MATCHING NETWORK
RF TRANSIMITTER
STORAGE TRAILERS
SOIL STOCKPILE
S1TW08
S1TW09
TRANSFORMER
ACCESS GATE
14' ACCESS GATE
MW00
MATERIAL STORAGE
CRIVE
LEGEND
SECURITY FENCE
EXCLUSION ZONE BOUNDARY
GROUNDWATER WELL
OVERHEAD ELECTRIC LINE
POWER POLE
N
30 0 30
SCALE: 1" = 30'
DRAWN
CHECKED
GEOLOGIST
ENGINEER
DISC. MAN.
PROJ. MAN.
TITLE
IITRI SITE PLAN
SITE S-1 (RF HEATING)
KELLY AIR FORCE BASE
SAN ANTONIO, TEXAS
SCALE
AS SHOWN
DATE
12 6 94
DRAWING NO.
36880013
1 of 1

FIGURE A.8.-1

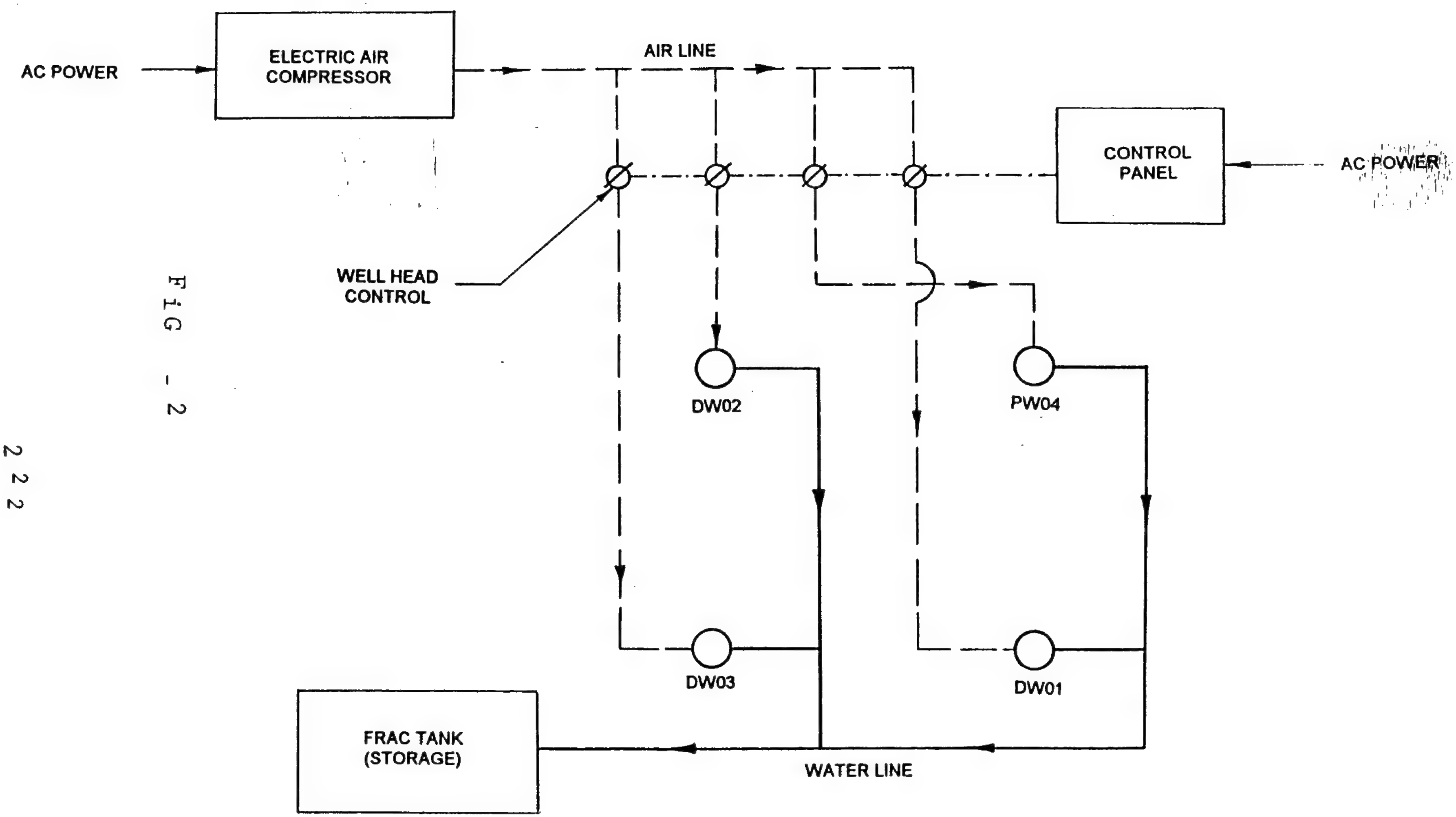

FIGURE A.8.-2
DEWATERING SYSTEM SCHEMATIC
IITRI DEMONSTRATION
SITE S-1, KELLY AFB

FiG _ 2

III. OPERATION

Dewatering began on February 2, 1993, using wells DW03 and S1PW04. Wells DW01 and DW02 came on line a few days later and the pumping levels were adjusted to match recharge in the wells. The dewatering system was turned off on February 13, 1993, to allow the aquifer to recharge to equilibrium before a test was performed to see how quickly and to what depth the water table could be lowered. Table G.-1 illustrates the results of the dewatering system during this test. When the dewatering system was turned off the water level at temporary well PW03 was 24.5 below the surface and rose to 22.6 feet below the surface before the system was turned on again on February 15. The dewatering system was able to lower the water table in the demonstration area 1.9 feet in twenty-four hours. PW03 was installed on January 28, 1993, to collect water levels in the demonstration area to determine the effectiveness of the dewatering system in lowering the water table. PW03 was abandoned on February 22, 1993, prior to the IITRI demonstration startup. From the results of the test it was concluded that the dewatering system would be able to keep the water table lowered 5 feet below the excitor electrodes. Water levels from PW03 and wells adjacent to the demonstration site are provided in Table A.8.-1.

Water removed by the dewatering system was collected in a holding tank at the site and transported to the Kelly AFB EPCF for treatment. Initially the water was collected in a tanker truck and transported to the EPCF in the tanker truck. Beginning in April 1993 the water was collected in a frac tank then transferred to a tanker truck for transport to the EPCF.

IV. CONCLUSIONS

Volumes of water, average pumping rates, rainfall, and water transport data during the period of the IITRI demonstration are provided in Table G.-2. Average pumping rates ranged from 0.79 gpm to 3.79 gpm during the demonstration. Variations in pumping rates can be attributed to various factors including precipitation, evaporation, recharge of the aquifer, and the nearby pond at the fuel tank farm to the east of the demonstration site. The dewatering system was able to draw the water table at the demonstration site down to a level of approximately 24.5 feet during a pump test in February 1993. The goal was to be able to draw the water table down to approximately 5 feet below the bottom of the exciter electrodes which was at a depth of approximately 20 feet. Actual water levels during the demonstration may have been even lower due to the continual dewatering over a longer period of time.

TABLE G.-1
WATER LEVELS
SITE S-1, KELLY AFB

Date	Time	Well Number								
		PW03	PW04	DW01	DW02	DW03	TW09	TW10	TW11	TW12
1/30/93	2:15 PM			23.74	22.4	23.17				
2/2/93	7:30 AM	22.47	24.63	23.80	22.58	23.28	24.39	23.80	23.66	23.92
2/2/93	9:15 AM	22.75	35.35		25.97			23.85	23.83	
2/2/93	12:30 PM	23.47	32.83		25.78			23.85	23.85	
2/2/93	1:20 PM	23.11								
2/2/93	3:20 PM	23.45								
2/3/93	6:43 PM	23.78	34.99	29.78	28.27	24.17	24.43	23.95	24.07	26.28
2/3/93	1:15 PM		34.89		27.8			23.95	24.14	26.21
2/3/93	6:30 PM	22.41	33.55		27.78			23.88	24.23	26.14
2/4/93	7:30 AM	23.7		30.02	27.75			23.96	24.4	26.09
2/4/93	12:40 PM	22.9	34.95	29.91	27.69	24.18	24.49	23.97	24.35	26.11
2/4/93	4:00 PM	23.84		29.74	28.02			24	24.54	26.08
2/7/93	1:30 PM	23.44						23.92	24.24	25.76
2/7/93	5:38 PM	23.47								
2/8/93	6:46 AM	23.6								
2/8/93	1:10 PM	23.35								
2/8/93	6:14 PM	23.46							24.67	25.39
2/9/93	8:08 AM	22.85						24.1	24.45	24.21
2/9/93	10:50 AM	22.98						24.13	24.22	24.67
2/9/93	12:50 PM	23.12							24.28	25
2/9/93	4:35 PM	23.46							24.14	25.73
2/10/93	8:35 AM	20.59						24.16	24.22	24.12
2/10/93	1:55 AM	22.08						24.1	24.27	25.52
2/11/93	8:10 AM	23.26				23.73		24.13	24.23	25.69
2/11/93	1:00 PM	23.47				25.64		24.15	24.25	25.67
2/12/93	2:00 PM	24.8							24.3	26.8
2/13/93	7:30 AM	24.5								
2/13/93	1:00 PM	24.5								25.96
2/15/93	8:30 AM	22.6								
2/16/93	8:30 AM	24.4								
2/16/93	2:00 PM	24.6								
2/18/93	7:30 AM	24.71								
2/19/93	7:55 AM	24.68								

Table G.-2
Dewatering Data Summary
IITRI Demonstration
Site S-1, Kelly AFB, TX

Item	Date	Quantity (gal)	Days	Gallons per day	Rainfall (in)	Average gpm
March					**2.21**	
Start-up	4/3/94	0			0.19	
Water Hauling	4/12/93	16,000	9		0.25	1.23
Water Hauling	4/19/93	16,000	7		0	1.59
Water Hauling	4/28/93	16,000	9		0	1.23
April		**48,000**	**25**	**1920**	**0.44**	**1.33**
Water Hauling	5/5/93	8,000	7		3.91	0.79
Water Hauling	5/8/93	16,000	3		0	3.70
Water Hauling	5/14/93	16,000	6		0	1.85
Water Hauling	5/18/93	5,460	4		0.06	0.95
Water Hauling	5/19/93	5,460	1		0	3.79
Water Hauling	5/25/93	18,000	6		3.01	2.08
Water Hauling	5/31/93	14,000	6		1.14	1.62
May		**82,920**	**33**	**2513**	**8.12**	**1.74**
Water Hauling	6/5/93	12,000	5		0	1.67
Water Hauling	6/10/93	18,000	5		0.28	2.50
Water Hauling	6/16/93	18,000	6		3.3	2.08
Water Hauling	6/22/93	12,000	6		1.29	1.39
Water Hauling	6/25/93	12,000	3		0.33	2.78
Water Hauling	6/28/93	12,000	3		0.73	2.78
June		**84,000**	**28**	**3000**	**5.93**	**2.08**
Water Hauling	7/2/93	12,000	4		0	2.08
Water Hauling	7/6/93	12,000	4		0	2.08
Water Hauling	7/13/93	18,000	7		0	1.79
Water Hauling	7/16/93	6,000	3		0	1.39
Water Hauling	7/23/93	6,000	7		0	0.60
Water Hauling	7/27/93	18,000	4		0	3.13
July		**72,000**	**29**	**2483**	**0**	**1.72**
Water Hauling	8/6/93	18,000	10		0	1.25
Water Hauling	8/23/93	21,000	17			0.86
August		**39,000**	**27**	**1444**		**1.00**
TOTAL		**325,920**	**115**	**2834**	**16.70**	**1.38**

APPENDIX H

PRECISION ANALYTICS, INC.

N.E. 2345 Hopkins Court • Pullman, WA 99163
TEL. (509) 332-0928

May 4, 1993

SA-ALC/PKOE
1288 Growdon Road, Bldg. 1585
Kelly AFB, TX 78241-5318

Attn: JoAnn Hernandez

Laboratory Reference
Samples: 3117KAB1, 3117KAB2
Report number: KAB3117

Customer Reference
CALL #93-36
Samples: S1-3109-01, S1-3109-02

Date samples received: 4/20/93

All analyses are performed by approved methodologies whenever applicable. Deviations, modifications and/or substitutions with more stringent EPA methodologies are sometimes necessary owing to the variety of matrices being analyzed.

A *Concentration Value* of U indicates a compound could not be detected in the sample above the lower quantitation limit printed in the *Detection Limit* column.

If you have any questions regarding the enclosed laboratory results, please include the above laboratory sample and report numbers in all correspondence.

Respectfully,

Michael McMillan

Michael McMillan, Ph.D.
Chemist

Chemist: McMillan
Client Sample ID: S1-3109-01
Lab Sample Number: 3117KAB1

Date completed: 5/4/93
Sample type: Water
Method: EPA 8020

Item Number	Compound	Detection Limit µg/L (ppb)	Concentration µg/L (ppb)
1	Benzene	5	1319
2	Toluene	5	195
3	Ethylbenzene	5	41
4	Xylene I	5	15
5	Xylene II	5	48
6	Chlorobenzene	5	5747
7	1,2-dichlorobenzene	5	2700
8	1,3-dichlorobenzene	5	230
9	1,4-dichlorobenzene	5	964

Precision Analytics, Inc.

Chemist: McMillan
Client Sample ID: S1-3109-02
Lab Sample Number: 3117KAB2

Date completed 5/4/93
Sample type. Water
Method: EPA 8270

Item Number	Compound	Detection Limit µg/L (ppb)	Concentration µg/L (ppb)
1	2-Fluorophenol	S	--
2	Phenol-d_5	S	--
3	bis(2-Chloroethyl)Ether	660	U
4	1,4-Dichlorobenzene-d_4	*	--
5	2-Chlorophenol-d_4	S	--
6	2-Chlorophenol	660	U
7	1,3-Dichlorobenzene	660	85
8	1,4-Dichlorobenzene	660	265
9	1,2-Dichlorobenzene	660	555
10	2-Methylphenol	660	43.7
11	Phenol	660	U
12	bis(2-Chloroisopropyl)Ether	660	U
13	Benzyl Alchohol	1,300	U
14	3-Methylphenol	660	U
15	4-Methylphenol	660	16
16	N-nitroso-Di-n-propylamine	660	U
17	Nitrobenzene-d_5	S	--
18	Hexachloroethane	660	U
19	Nitrobenzene	660	U
20	2-Nitrophenol	660	U
21	Isophorone	660	U
22	2,4-Dimethyphenol	660	22
23	Benzoic Acid	3,300	U
24	bis(2-Chloroethoxy)methane	660	U
25	2,4-Dichlorophenol	660	U

Client Sample ID: SA-3109-02 Lab Sample Number: 3117KAB2

Item Number	Compound	Detection Limit µg/L (ppb)	Concentration µg/L (ppb)
26	Naphthalene-d_8	*	--
27	1,2,4-Trichlorobenzene	660	6
28	Naphthalene	660	84
29	4-Chloroaniline	1,300	U
30	Hexachlorobutadiene	660	U
31	2-Methylnaphthalene	660	U
32	4-Chloro-3-Methylphenol	1,300	U
33	Hexachlorocyclopentadiene	660	U
34	2,4,6-Trichlorophenol	660	U
35	2,4,5-Trichlorophenol	660	U
36	2-Fluorobiphenyl	$	--
37	2-Nitroaniline	3,300	U
38	2-Chloronaphthalene	660	U
39	Dimethyl Phthalate	660	U
40	2,6-Dinitrotoluene	660	U
41	Acenaphthylene	660	U
42	3-Nitroaniline	3,300	U
43	Acenaphthene-d_{10}	*	--
44	2,4-Dinitrophenol	3,300	U
45	Dibenzofuran	660	U
46	Acenaphthene	660	U
47	4-Nitrophenol	3,300	U
48	2,4-Dinitrotoluene	660	U
49	Diethyl phthalate	660	U
50	4,6-Dinitro-2-methylphenol	3,300	U

Client Sample ID: SA-3109-02 Lab Sample Number: 3117KAB2

Item Number	Compound	Detection Limit µg/L (ppb)	Concentration µg/L (ppb)
51	4-Nitroaniline	ND	U
52	Fluorene	660	U
53	4-Chlorophenyl phenyl ether	660	U
54	N-nitrosodiphenylamine	660	U
55	Diphenyldiazene	660	U
56	2,4,6-Tribromophenol	$	--
57	4-Bromophenyl phenyl ether	660	U
58	Hexachlorobenzene	660	U
59	Pentachlorophenol	3,300	U
60	Phenanthrene	660	U
61	Phenanthrene-d_{10}	*	--
62	Anthracene	660	U
63	Di-n-Butylphthalate	660	U
64	Fluoranthene	660	U
65	Pyrene	660	U
66	4-Terphenyl-d_{14}	$	--
67	Chrysene	660	U
68	Butyl benzyl phthalate	660	U
69	3,3'-Dichlorobenzidine	1,300	U
70	Perylene-d_{12}	*	--
71	Benzo(a)Anthracene	660	U
72	bis(2-ethylhexyl)Phthalate	660	U
73	Benzo(a)pyrene	660	U
74	Di-n-octyl Phthalate	660	U
75	Dibenz(a h)anthracene	660	U
76	Benzo(b+k)fluoranthene	660	U

Precision Analytics, Inc.

Client Sample ID: SA-3109-02 Lab Sample Number: 3117KAB2

Item Number	Compound	Detection Limit µg/L (ppb)	Concentration µg/L (ppb)
77	Benzo(g,h,i)perylene	660	U
78	Indeno(1,2,3-cd)pyrene	660	U
79	Chrysene-d_{12}	*	--

$ = Surrogate * = Internal Standard

Comment: 500 ml of sample were concentrated to 1.8 ml of organic extract; hence, effective detection limits are .0036 of machine detection limits listed.

APPENDIX I

Report of Analysis

JUN 1993
RECEIVED

Consulting Geotechnical Materials and Environmental Engineers
Geologists Scientists and Chemists

Raba-Kistner
Consultants, Inc.

P O Box 690287, San Antonio TX 78269-0287
12821 W. Golden Lane San Antonio TX 78249
(210) 699-9090

To: Halliburton NUS Corp.
800 Oak Ridge Turnpike
Jackson Plaza, A-600
Oak Ridge, TN 37830
Attn: Cliff Blanchard

Project No.: ASE93-018-00
Task No.: 5000
Assignment No.: 3893
Contract/P.O. No.:
Date Received: 5-14-93
Page 1 of 6 Date: 6-2-93

Sample Type/Sample Loc: Water/Kelly AFB
Date Collected: 5-14-93
Date Completed: 5-27-93
Collected By: Client

TEST METHODS:

TEST	PREPARATION/DATE	ANALYSIS/DATE
Semi-Volatiles	SW 846 3510/5-17-93	SW 846 8270/5-21-93
TPH		EPA 418.1/5-18-93
Volatiles	SW 846 5030/5-17-93	SW 846 8260/5-17-93

All soil and sludge results are reported on the dry-weight basis.
Methods are from EPA SW 846 and EPA 600/4-79-20 or as listed.

By ES Moore
Earl S. Moore
Organic Section Manager

By Edward J. Brown
Edward J. Brown

Project No.: ASE93-018-00
Assignment No.: 3893

BASE/NEUTRAL/ACID EXTRACTABLES	Detection Limit ug/L	3893-1 (S1W0514 931050D) ug/L
Acenaphthene	10	<10
Acenaphthylene	10	<10
Anthracene	10	<10
Benzo(a)anthracene	10	<10
Benzo(b)fluoranthene	10	<10
Benzo(k)fluoranthene	10	<10
Benzo(a)pyrene	10	<10
Benzo(g,h,i)perylene	10	<10
Benzoic acid	50	140
Benzyl alcohol	20	26
Benzidine	10	<10
Benzyl butyl phthalate	10	<10
Bis(2-chloroethyl)ether	10	<10
Bis(2-chloroethoxy)methane	10	<10
Bis(2-ethylhexyl)phthalate	10	95
Bis(2-chlorisopropyl)ether	10	<10
4-Bromophenyl phenyl ether	10	<10
4-Chloroaniline	20	<10
2-Chloronaphthalene	20	<10
4-Chlorophenyl phenyl ether	10	<10
Chrysene	10	<10
Dibenzofuran	10	<10
Dibenzo(a,h)anthracene	10	<10
Di-n-butyl phthalate	10	16
1,3-Dichlorobenzene	10	<10
1,4-Dichlorobenzene	10	<10
1,2-Dichlorobenzene	10	<10
3,3'-Dichlorobenzidine	20	<20
Diethyl phthalate	10	<10
Dimethyl phthalate	10	<10
2,4-Dinitrotoluene	10	<10
2,6-Dinitrotoluene	10	<10
Di-n-octylphthalate	10	<10
1,2-Diphenylhydrazine	10	<10
Fluoranthene	10	<10
Fluorene	10	<10
Hexachlorobenzene	10	<10
Hexachlorobutadiene	10	<10
Hexachloroethane	10	<10
Indeno(1,2,3-cd)pyrene	10	<10
Isophorone	10	<10
2-Methylnaphthalene	10	<10
Naphthalene	10	<10

2-Nitroaniline	50	<50
3-Nitroaniline	50	<50
4-Nitroaniline	50	<50
Nitrobenzene	10	<10
N-Nitrosodimethylamine	10	<10
N-Nitrosodi-n-propylamine	10	<10
N-Nitrosodiphenylamine	10	<10
Phenanthrene	10	<10
Pyrene	10	<10
1,2,4-Trichlorobenzene	10	<10
4-Chloro-3-methylphenol	20	<20
2-Chlorophenol	10	<10
2,4-Dichlorophenol	10	<10
2,4-Dimethylphenol	10	50
2,4-Dinitrophenol	50	<50
2-Methyl-4,6-dinitrophenol	50	<50
2-Methylphenol	10	14
4-Methylphenol	10	300
2-Nitrophenol	10	<10
4-Nitrophenol	50	<50
Pentachlorophenol	50	<50
Phenol	10	120
2,4,6-Trichlorophenol	10	<10
2,4,5-Trichlorophenol	10	<10

Test Results:

Analyte	Detection Limit (mg/L)	3893-1 (S1W0514 931050D) (mg/L)
TPH	1	5

Project No.: ASE93-018-00
Assignment No.: 3893
Page 5 of 6

Test Results:

Analyte	Detection Limit (mg/L)	3893-1 (S1W0514 931050D) (mg/L)	3893-2 (SW0514 931045C) (mg/L)
Acetone	1	2.4	12
Bromomethane	0.1	<0.1	1.3
2-Butanone	1	<1	<1
Carbon disulfide	1	<1	<1
Chloroethane	0.1	<0.1	<0.1
Chloroform	0.05	<0.05	<0.05
Chloromethane	0.1	<0.1	<0.1
Dichlorodifluoromethane	0.05	<0.05	<0.05
1,1-Dichloroethane	0.05	<0.05	<0.05
1,2-Dichloroethane	0.05	<0.05	<0.05
1,1-Dichloroethene	0.05	<0.05	<0.05
cis-1,2-Dichloroethene	0.05	<0.05	<0.05
trans-1,2-Dichloroethene	0.05	<0.05	<0.05
1,2-Dichloropropane	0.05	<0.05	<0.05
Methylene chloride	0.05	<0.05	<0.05
1,1,1-Trichloroethane	0.05	<0.05	<0.05
Trichlorofluoromethane	0.05	<0.05	<0.05
Vinyl acetate	0.5	<0.5	<0.5
Vinyl chloride	0.1	<0.1	<0.1
Benzene	0.05	<0.05	0.06
Bromodichloromethane	0.05	<0.05	<0.05
Carbon Tetrachloride	0.05	<0.05	<0.05
2-Chloroethyl vinyl ether	0.1	<0.1	<0.1
1,2-Dibromoethane	0.05	<0.05	<0.05
Dibromomethane	0.05	<0.05	<0.05
1,2-Dichloroethane	0.05	<0.05	<0.05
1,2-Dichloropropane	0.05	<0.05	<0.05
1,1-Dichloropropene	0.05	<0.05	<0.05
cis-1,3-Dichloropropene	0.05	<0.05	<0.05
trans-1,3-Dichloropropene	0.05	<0.05	<0.05
Methylbutyl ether	0.05	<0.05	<0.05
4-Methyl-2-pentanone	0.50	<0.50	<0.50
Toluene	0.05	<0.05	<0.05
1,1,2-Trichloroethane	0.05	<0.05	<0.05
Trichloroethene	0.05	<0.05	<0.05
Bromoform	0.05	<0.05	<0.05
Chlorodibromomethane	0.05	<0.05	<0.05
Chlorobenzene	0.05	0.07	0.09
1,3-Dichloropropane	0.05	<0.05	<0.05
Ethylbenzene	0.05	<0.05	<0.05
2-Hexanone	0.50	<0.50	<0.50
Styrene	0.05	<0.05	<0.05
1,1,2,2-Tetrachloroethane	0.05	<0.05	<0.05
Tetrachloroethene	0.05	<0.05	<0.05
Total Xylenes	0.05	<0.05	<0.05

APPENDIX J

Engineers, Geologists, Chemists, Water Planners, Hygienists and Environmental Scientists

Raba-Kistner
Consultants, Inc.

12821 W. Golden Lane
P.O. Box 690287, San Antonio, TX 78269-0287
(210) 699-9090 • FAX (210) 699-6426

December 22, 1994

Ms. Laura Witt
Brown & Root Environmental
800 Oak Ridge Turnpike, Suite A-600
Oak Ridge, Tennessee 37830

Dear Laura,

The samples submitted under chain-of-custody number 6756 were referenced as "soil" on the report dated 04-26-94. The samples submitted were actually carbon; however, our boilerplate default is "soil" for all solid matrices.

If you have any questions or need additional information, please contact me at 210-699-9090, extension 275.

Respectfully submitted,

RABA-KISTNER CONSULTANTS, INC.

AL Weilbacher
Director of Analytical Chemistry

San Antonio • El Paso • Austin

	Detection Limit (mg/L)	3893-1 ($1W0514 931050D) (mg/L)	3893-2 (SW0514 931045C) (mg/L)
Bromobenzene	0.05	<0.05	<0.05
n-Butylbenzene	0.05	<0.05	<0.05
sec-Butlybenzene	0.05	<0.05	<0.05
tert-Butylbenzene	0.05	<0.05	<0.05
2-Chlorotoluene	0.05	<0.05	<0.05
4-Chlorotoluene	0.05	<0.05	<0.05
1,2-Dibromo-3-chloropropane	0.05	<0.05	<0.05
1,2-Dichlorobenzene	0.05	<0.05	<0.05
1,3-Dichlorobenzene	0.05	<0.05	<0.05
1,4-Dichlorobenzene	0.05	<0.05	<0.05
Hexachlorobutadiene	0.05	<0.05	<0.05
Isopropyl benzene	0.05	<0.05	<0.05
p-Isopropyltoluene	0.05	<0.05	<0.05
Naphthalene	0.05	<0.05	<0.05
n-Propylbenzene	0.05	<0.05	<0.05
1,1,2,2-Tetrachloroethane	0.05	<0.05	<0.05
1,2,3-Trichlorobenzene	0.05	<0.05	<0.05
1,2,4-Trichlorobenzene	0.05	<0.05	<0.05
1,2,3-Trichloropropane	0.05	<0.05	<0.05
1,2,4-Trimethylbenzene	0.05	<0.05	<0.05
1,3,5-Trimethylbenzene	0.05	<0.05	<0.05

APPENDIX J

Report of Analysis

FILE COPY

Consulting Geotechnical Materials and Environmental Engineers
Geologists Scientists and Chemists

Raba-Kistner
Consultants, Inc.

P.O. Box 690287, San Antonio, TX 78269-0287
12821 W. Golden Lane, San Antonio, TX 78249
(210) 699-9090

To: Brown & Root Environmental
800 Oak Ridge Turnpike
Suite A-600
Oak Ridge, TN 37830

Attn: Cliff Blanchard

Project No: ASE94-007-00
Task No: 5000
Assignment No: 6756
Contract/P.O. No:
Date Received: 04-19-94
Page 1 **of** 5 **Date:** 04-26-94

Sample Type/Sample Loc: Soil / Kelly Air Force Base
Date Collected: 04-19-94
Date Completed: 04-26-94
Collected By: R-KCI

TEST METHODS:

TEST	PREPARATION / DATE	ANALYSIS / DATE
TCLP Extraction	1311 / 04-21-94	
TCLP-ZHE	1311 / 04-21-94	
TCLP-Volatiles		8260 / 04-25-94
TCLP-Semi-Volatiles	3510 / 04-22-94	8270 / 04-25-94

By [signature]
Gang Sun, Ph.D.
QA/QC Officer

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Analyte	**Detection Limit (mg/L)**	6756-1 (KSI CD 1/2-3688) **(mg/L)**
TCLP-Semi-Volatiles		
1,4-Dichlorobenzene	0.75	<0.75
2,4-Dinitrotoluene	0.013	<0.013
Hexachlorobenzene	0.013	<0.013
Hexachloroethane	0.03	<0.05
Nitrobenzene	0.02	<0.02
Pentachlorophenol	3.6	<3.6
2,4,6-Trichlorophenol	0.2	<0.2
2,4,5-Trichlorophenol	5.8	<5.8
Pyridine	0.5	<0.5
Total cresol	30	<30

Analyte TCLP-Volatiles	**Detection Limit (mg/L)**	6756-1 (KSI CD 1/2-3688) **(mg/L)**
Benzene	0.05	<0.05
Carbon Tetrachloride	0.05	<0.05
Chlorobenzene	10	<10
Chloroform	0.6	<0.6
1,2-Dichlroethane	0.05	<0.05
1,1-Dichloroethene	0.07	<0.07
2-Butanone	20	<20
Tetrachloroethene	0.07	<0.07
Trichloroethene	0.05	<0.05
Vinyl Chloride	0.02	<0.02

QA/QC FORM

	ORIGINAL RESULT (mg/L)	MATRIX SPIKE AMT. (mg/L)	MATRIX SPIKE RECOVERY (%)	MATRIX SPIKE DUPLICATE RECOVERY (%)	QC LIMITS (%)	RELATIVE DIFFERENCE	QC RPD	SAMPLE
1,1-Dichloroethene	10	100	117	128	61-145	9	14	Blank
Trichloroethene	10	100	100	111	71-120	10	14	Blank
Benzene	10	100	110	121	76-127	10	11	Blank
Toluene	10	100	104	115	76-127	10	13	Blank
Chlorobenzene	10	100	127	124	75-130	2	13	Blank

QA/QC FORM

	ORIGINAL RESULT (mg/L)	MATRIX SPIKE AMT. (mg/L)	MATRIX SPIKE RECOVERY (%)	MATRIX SPIKE DUPLICATE RECOVERY (%)	QC LIMITS (%)	RELATIVE DIFFERENCE	QC RPD	SAMPLE
Phenol	<10	200	32	17	5-112	17	23	Blank
2-Chloro-phenol	<10	200	60	52	23-134	14	29	Blank
1,4-Dichloro-benzene	<10	100	59	51	20-124	15	32	Blank
N-Nitroso-di-n-propylamine	<10	100	62	55	D-230	12	55	Blank
l,2,4-Trich-lorobenzene	<10	100	67	58	44-142	15	28	Blank
4-Chloro-3-methylphenol	<10	200	100	92	22-147	8	37	Blank
Acenaphthene	<10	100	71	64	47-145	10	28	Blank
4-Nitrophenol	<10	200	64	64	D-132	0	47	Blank
2,4-Dinitroto-luene	<10	100	88	79	39-139	11	22	Blank
Pentachloro-phenol	<10	200	124	114	14-176	8	49	BLank

6.10.6

HALLIBURTON NUS Environmental Corporation and Subsidiaries

CHAIN OF CUSTODY RECORD

PROJECT NO.: 3688

SITE NAME: SITE S-1, KELLY AFB, TX

SAMPLERS (SIGNATURE): Paul F. Deeley

STATION NO.	DATE	TIME	COMP	GRAB	~~STATION LOCATION~~ SAMPLE NUMBER (ID)	NO. OF CONTAINERS	TCLP VOAs w/ SEMI-VOAs					REMARKS: P.O. # 2047-3688-P000313
CD 1 2	04/19 1994	0832	X		KS1-CD1/2-3688	3	X					ONE SAMPLE IN 3 PARTS
												SEND ORIGINAL LAB REPORT
												OF RESULTS TO:
												MR. CLIFF BLANCHARD
												BROWN & ROOT ENVIRONMENTAL
												800 OAK RIDGE TURNPIKE A-600
												OAK RIDGE, TN 37830
												(615) 483-9900
												SEND INVOICE TO KAREN SHERROD AT ABOVE ADDRESS
												FAX RESULTS ~~ASAP~~ TO:
												CLIFF BLANCHARD (615) 483-2014 AND
												RAY BETTMENG (210) 927-1118

RELINQUISHED BY (SIGNATURE):	DATE / TIME:	RECEIVED BY (SIGNATURE):	RELINQUISHED BY (SIGNATURE):	DATE / TIME:	RECEIVED BY (SIGNATURE):
Paul F. Deeley	4/19/94 0955	[illegible signature]		4-19-94 11:10	Anna Singletary
RELINQUISHED BY (SIGNATURE):	DATE / TIME:	RECEIVED BY (SIGNATURE):	RELINQUISHED BY (SIGNATURE):	DATE / TIME:	RECEIVED BY (SIGNATURE):
RELINQUISHED BY (SIGNATURE):	DATE / TIME:	RECEIVED FOR LABORATORY BY (SIGNATURE):	DATE / TIME:	REMARKS:	

NUS 440 REVISED 0891

APPENDIX K

TABLE
IITRI COST SUMMARY - PHASE II
RF SOIL DECONTAMINATION DEMONSTRATION

ITEM	UNIT COST ($)	SUBTOTALS
RF SOURCE		
RF TRANSMITTERS		**$883,852**
RF CONTROL UNIT	242,000	
ELECTRICITY	600,000	
RF APPLICATION	41,852	
EXCITOR ELECTRODES		**$25,244**
COAXIAL TRANSMISSION LINE	11,280	
GROUND ELECTRODES	2,300	
RF SHIELD	11,664	
DOGHOUSE		**$7,217**
MESH SCREEN	6,664	
MEASUREMENT/CONTROL	553	
THERMAL MEASUREMENT WELLS (TMW)		**$21,670**
VACUUM MEASUREMENT WELLS (VMW)	66	
THERMOCOUPLES (TCs) AND WIRE	29	
VACUUM/PRESSURE GAUGES	3,437	
GAS CHROMATOGRAPH	138	
VAPOR COLLECTION/TRANSFER PIPING	18,000	
VAPOR BARRIER		**$3,541**
GROUND ELECTRODE PIPING	1,492	
HORIZONTAL EXTRACTION PIPING	1,188	
EXTRACTION MANIFOLD	363	
VAPOR EXTRACTION/TREATMENT	497	
REGENERATIVE BLOWER		**$251,700**
CATOX TREATMENT UNIT	1,700	
SITE SUPPORT	250,000	
UTILITY TRUCK		**$80,050**
CELLULAR TELEPHONE	35,000	
MISCELLANEOUS ODCS	4,875	
FENCING	47,560	
GRAVEL	9,200	
CONCRETE	2,500	
WASTE DISPOSAL	7,108	
LIGHTS	7,108	
SUBCONTRACTOR SUPPORT	1,700	
DRILLING FOR SYSTEM INSTALL		**$190,954**
IN GROUND SYSTEM ABANDONMENT	24,664	
RF CONSULTANTS	23,390	
ANALYTICAL	100,000	
LABOR	42,900	
SITE PREPARATION/SET-UP		**$477,389**
TREATMENT	55,688	
SITE RESTORATION/DEMOBILIZATION	403,139	
	18,563	
	SUBTOTAL	**$1,941,617**
ODC MARKUP	10.60%	**$155,208**
ENGINEERING, PROCUREMENT, & PROJECT MANAGEMENT	15%	**$219,634**
CONTENGENCY	15%	**$219,634**
	TOTAL	**$2,536,093**

TABLE
IITRI COST DETAILS - PHASE II
RF SOIL DECONTAMINATION DEMONSTRATION

ᴵUT PARAMETERS

ATMENT AREA (FT)	LENGTH	44	EXCITOR TO EXCITOR (FT)	4	HEAT TIME, WKS/CELL	8
	WIDTH	32	EXCITOR TO GROUND (FT)	8	COOL TIME, WKS	4
	DEPTH	20	GROUND TO GROUND (FT)	4		
CELL AREA (FT)	WIDTH	16	EXCITOR ELECTRODE DEPTH (FT)	20	TREATMENT TIME (WKS)	20
	LENGTH	32	GROUND ELECTRODE DEPTH (FT)	28	MOB/DEMOB TIME (WKS)	6
	DEPTH	20	VAP. BARRIER OVERLAP (FT)	10		

RF SOURCE

RF TRANSMITTERS

25kW/240V TRANSMITTERS INCLUDES TRAILER, DUMMY LOAD, CHOKES, ELECTRIC FIELD MEASUREMENT EQUIPMENT, TRANSFORMERS, MATCHING NETWORKS OR TUNERS, INSTRUMENTATION FOR ELECTRICAL/RF/TEMPERATURE DATA MANAGEMENT, AND TOOLS — **$242,000.00** CAPITAL

100	POWER REQUIRED FOR SYSTEM (kW)
25	INDIVIDUAL TRANSMITTER POWER (kW)
$55,000.00	COST PER TRANSMITTER
$22,000.00	COST FOR TRAILER
$242,000.00	TOTAL TRANSMITTER/TRAILER COST

RF CONTROL UNIT

HOUSED IN 40' SEMI TRAILER WITH COMPUTERIZED INSTRUMENTATION FOR THE MONITORING AND CONTROL OF RF, ELECTRICAL, TEMPERATURE, VAPOR FLOW AND TREATMENT. THIS TRAILER WILL ALSO HOUSE THE SITE OFFICE AND GC LAB AREA. — **$600,000.00** CAPITAL

$600,000.00	COST FOR CONTROL UNIT (EST/KAI)

ELECTRICITY — **$41,852.16** DISPOSABLES

$0.07	COST PER KILOWATT HOUR
170	POWER USAGE IN KW/H DURING HEATING
3,360	HEATING HOURS (168/WK X TREATMENT TIME)
571,200	KWH USED DURING HEATING
15	POWER USAGE IN KW/H DURING COOLING/OTHER
672	COOLING/OTHER HOURS (168/WK X COOLING AND MOB/DEMOB TIME)
10,080	KWH USED DURING COOLING/OTHER
581,280	TOTAL KWH USED FOR PROJECT
$41,852.16	TOTAL COST FOR ELECTRICITY

RF APPLICATION

EXCITOR ELECTRODES

ALL ARE CONSTRUCTED OF SCH 40 COPPER PIPE WITH BOTTOM PLUGS — **$11,280.00** CAPITAL
OUTSIDE TWO EXCITORS ARE 3" DIAM. TOPPED WITH 3"/6" COPPER ELBOWS (90) INSET 4' FROM END OF CELL
INSIDE EXCITORS ARE 2" DIAM. TOPPED WITH 2" x 6" x 6" COPPER TEES
ALL EXCITORS TIED TOGETHER BY 6" DIAM. SCH 40 COPPER PIPE
MATERIALS TO MAKE UP 2 ROWS OF EXCITORS (PIPE AND CAP) REQUIRED

12	NO. OF 2" DIAM. EXCITORS = CELL LENGTH - INSET/SPACING - NO. OF 3" DIAM. EXCITORS
240	TOTAL LF = NO. OF EXCITORS PER CELL X DEPTH X 2 ROWS
$24.00	COST PER LF FOR 2" DIAM. SCH 40 COPPER PIPE (EST.)
$5,760.00	COST FOR 2" DIAM. EXCITORS = COST PER LF X TOTAL LF
$150.00	COST FOR EACH COPPER 2"/6"/6" TEE AND BOTTOM PLUG (EST)
$1,800.00	COST FOR TEES/CAPS = EXCITORS PER CELL X COST PER TEE/PLUG
4	NO. OF 3" DIAM. EXCITORS (PER ROW = 2)
80	TOTAL LF = NO. OF EXCITORS PER CELL X DEPTH
$38.00	COST PER LF FOR 3" DIAM. SCH 40 COPPER PIPE (SAIC EST.)
$3,040.00	COST FOR 3" DIAM. EXCITORS = COST PER LF X TOTAL LF
$170.00	COST FOR EACH COPPER 3"/6"/6" TEE AND BOTTOM PLUG (EST)
$680.00	COST FOR TEES/CAPS = NO. OF EXCITORS X COST PER TEE/PLUG

		$2,300.00	CAPITAL

COAXIAL TRANSMISSION LINE
CONSTRUCTED OF 6" SCH 40 COPPER PIPE IN 3 SECTIONS TIED WITH FLANGES
TIES RF SOURCE TO MID-POINT OF EXCITOR ELECTRODE ROW, EXTENDS 20' FROM GROUND ROW

$120.00	COPPER ELBOW (EST)
$200.00	COPPER TEE (EST)
$45.00	COST PER LF - 6" DIAM. SCH 40 COPPER PIPE (EST.)
42	TOTAL LF = 0.5 X GROUND ROW LENGTH + 20'
$30.00	6" DIAM. COPPER COMPATIBLE FLANGES
$2,300.00	TOTAL COST = PIPE, 6 FLANGES, 1 TEE AND 1 ELBOW

		$11,664.00	CAPITAL

GROUND ELECTRODES
ALL GROUNDS ARE CONSTRUCTED OF 3" DIAM. SCH 40 ALUMINUM PIPE WITH COUPLING AND BOTTOM PLUG
ALL GROUNDS ARE TOPPED WITH 3"/2" ALUMINUM ELBOWS WITH ALUMINUM BUS BAR BRACKETS
GROUND ELECTRODES TIED TOGETHER WITH BUS BARS
MATERIALS TO MAKE UP 3 ROWS OF GROUNDS (PIPE, COUPLING, BOTTOM PLUG, AND ELBOW)

36	NO. OF GROUNDS = ROWS X 12
1008	TOTAL LF = NO. OF GROUNDS PER CELL X 1.5 CELLS (3 ROWS) X DEPTH
$8.00	COST PER LF FOR 3" DIAM. SCH 40 ALUMINUM PIPE (EST.)
$8,064.00	COST FOR 3" DIAM. GROUNDS = COST PER LF X TOTAL LF
$100.00	COST FOR ALUMINUM ELBOW, COUPLING, AND BOTTOM PLUG SET
$3,600.00	COST FOR ELBOWS/CAPS = GROUNDS PER CELL X COST PER ELBOW/PLUG

RF SHIELD

		$6,663.78	CAPITAL

DOGHOUSE
CONSTRUCTED OF 0.050 CORRUGATED ALUMINUM SHEETS AND 1/8" ALUMINUM END PLATES

5.80	COST PER SQUARE FOOT OF 2.67 X 7/8 CORRUGATED ALUMINUM
905	SQUARE FEET OF ALUMINUM SHEET REQUIRED
$5,246.73	TOTAL COST FOR CORRUGATED ALUMINUM SHEETING
7.05	COST PER SQUARE FOOT FOR ALUMINUM PLATE END WALLS
201	SQUARE FEET OF ALUMINUM PLATE REQUIRED
$1,417.05	TOTAL COST FOR ALUMINUM PLATE
$6,663.78	TOTAL COST FOR DOGHOUSE

		$552.96	DISPOSABLE

MESH SCREEN
EXTENDS 10' OUT FROM PERIMETER OF DOGHOUSE IN ALL DIRECTIONS

0.32	COST PER SQUARE FOOT OF ALUMINUM MESH
1728	SQUARE FEET OF ALUMINUM MESH REQUIRED
$552.96	TOTAL COST FOR ALUMINUM MESH

MEASUREMENT/CONTROL

		$65.70	DISPOSABLE

THERMAL MEASUREMENT WELLS (TMW)
TMWs ARE CONSTRUCTED OF 3" DIA GREEN THREAD FIBERGLASS PIPE COMPLETED 2' AGL

6	NO. OF TMWs
180	LF OF TMWs= NO. OF TMWsX (GROUND ELECTRODE DEPTH + 2' STICKUP)
$7.30	COST PER 20 LF OF 3" DIAM. GREEN THREAD FIBERGLASS (ACT.)
$65.70	COST FOR TOTAL LF OF TMWs = TOTAL LF/20 X COST PER 20 LF

		$28.80	DISPOSABL

PRESSURE MEASUREMENT WELLS (PMW)
PMWs ARE CONSTRUCTED OF 1" DIA SCH 40 PVC PIPE COMPLETED 2' AGL

8	NO. OF PMWs
30	LF PER PMW = GROUND ELECTRODE DEPTH + 2' STICKUP LENGTH
240	LF OF PMWs= NO. OF PMWs X PMW DEPTH
$2.40	COST PER 20 LF OF 1" DIAM. SCH 40 PVC PIPE (EST.)
$28.80	COST FOR TOTAL LF OF PMWs = TOTAL LF/20FT X COST PER 20 LF

THERMOCOUPLES (TCs) AND WIRE — **$3,437.12** — DISPOSABLE

EVERY 3RD EXCITOR ELECTRODE IN A ROW WILL HAVE K-TYPE TCs AT 6', 12' AND 18' DEPTHS
EACH TC WILL COME WITH 10' OF WIRE, EXTRA WIRE AND PLUG/JACK FOR EACH TC REQUIRED
ARE REQUIRED TO EXTEND 15' FROM TOP OF EXCITOR AT GROUND LEVEL

48	TOTAL TCs = TCs PER EXCITOR X EXACTERS PER ROW X 2 ROWS
$19.50	COST PER TC (EST.)
$936.00	TOTAL TC COST = TOTAL TCs X COST PER TC
176	LF WIRE FOR TCs AT 6' DEPTH = NO. OF 6' DC X 11 EXTRA FEET
272	LF WIRE FOR DC AT 12' DEPTH = NO. OF 12' DC X 17 EXTRA FEET
368	LF WIRE FOR DC AT 18' DEPTH = NO. OF 18' DC X 23 EXTRA FEET
816	TOTAL LF OF EXTRA WIRE
$584.00	COST PER 1000 LF OF WIRE (EST.)
$2,336.00	COST FOR WIRE = TOTAL LF (1000s) X COST PER 1000 LF
$4.30	COST OF PLUG/JACK FOR EXTRA WIRE (EST.)
48	TOTAL PLUG/JACKS = TOTAL DC
$165.12	TOTAL COST FOR PLUG/JACKS = TOTAL PLUG/JACKS X COST PER X 20% DISCOUNT (EST.)

VACUUM/PRESSURE GAUGES — **$138.00** — CAPITAL

MAGNAHELIC 0-10" AND 0-40" GAGES

46.00	COST PER GAUGE
3	GAUGES REQUIRED
$138.00	TOTAL COST FOR GAUGES

GAS CHROMATOGRAPH — **$18,000.00** — RENTAL

PORTABLE GC

3000.00	MONTHLY RENTAL RATE FOR PORTABLE GC
6.00	TOTAL MONTHS NEEDED
$18,000.00	TOTAL COST FOR PORTABLE GC RENTAL

VAPOR COLLECTION/TRANSFER PIPING

VAPOR BARRIER — **$1,492.48** — DISPOSABLE

3 LAYER BARRIER, TWO LAYERS OF REINFORCED PLASTIC AND ONE LAYER OF 2" INSULATION
BARRIER WILL EXTEND 12' BEYOND EDGE OF CELL IN ALL DIRECTIONS
INSULATION WILL COVER AREA UNDER SHIELD ONLY WITH NO OVERLAP

2240	PLASTIC BARRIER DIMENSIONS (SQ. FT) = (CELL WIDTH + 20') X (CELL LENGTH + 20')
1024	INSULATION DIMENSIONS (SQ. FT) = CELL WIDTH X CELL LENGTH
$0.13	COST PER SQ. FT. FOR REINFORCED PLASTIC BARRIER MATERIAL (EST.)
$0.16	COST PER SQ. FT. FOR 2" FIBERGLASS INSULATION (MCM CARR)
$1,492.48	COST FOR BARRIER = (.13/SQ. FT. X 4320 SQ. FT.) X 2 LAYERS + (.16/SQ. FT. X 1600 SQ. FT.) X 2 BARRIERS

GROUND ELECTRODE PIPING — **$1,188.42** — CAPITAL

FOUR GROUND ELECTRODE TIED TO 2" GREEN THREAD FIBERGLASS PIPE WITH BLACK 2" VACUUM HOSE
PIPE/ELECTRODE JUNCTION = TEE, 2 ADAPTERS, 2 COUPLING SETS, 2" BALL VALVE, AND 2' OF 2" VACUUM HOSE
EACH SECTION CONSTRUCTED IN TWO PIECES WITH A MIDPOINT FLANGE, AND END FLANGE

34.15	COST FOR 2" FIBERGLASS TEE (VEE)
5.00	COST FOR THREADED FIBERGLASS ADAPTER (VEE)
9.15	COST FOR 2" COUPLING (1 MALE/1 FEMALE) (VEE)
2.94	COST PER LV. OF VACUUM HOSE (VEE)
19.90	COST FOR 2" BRONZE BALL VALVE (ESCO)
15.50	COST FOR 2" FLANGE 15.50 (VEE)
88.23	COST FOR ONE JUNCTION (TEE, 2 ADAPTERS, 2 COUPLING SETS, BALL VALVE, AND 2' OF VACUUM HOSE
0.26	COST PER LF FOR 2" GREEN THREAD FIBERGLASS PIPE
28.00	COST FOR 2" FIBERGLASS END CAP
43.22	COST FOR PIPING ONE GROUND ELECTRODE ROW (CELL LENGTH + 10'), 2 FLANGES
$1,188.42	TOTAL COST = ((JUNCTION COST X JUNCTIONS PER ROW) + PIPING COST) X 3 ROWS

	$362.97	CAPITAL

HORIZONTAL EXTRACTION PIPING

TWO SECTIONS OF HORIZONTAL PIPING PER CELL CONSTRUCTED OF 2" GREEN THREAD FIBERGLASS PIPE
EACH SECTION CONSTRUCTED IN TWO PIECES WITH A FLANGE, END CAP, AND 2 ELBOWS

28.00	COST FOR 2" FIBERGLASS END CAP
15.50	COST FOR 2" FLANGE 15.50 (VEE)
0.26	COST PER LF. FOR 2" GREEN THREAD FIBERGLASS PIPE
9.15	COST FOR 2" SLEEVE COUPLING
23.65	COST FOR 2" 90 DEG. ELBOW
26	INDIVIDUAL SECTION LENGTH (CELL WIDTH + 10')
30	LENGTH OF PIPE IN FT (INDIV. SECTIONS)
1	SLEEVE COUPLINGS PER SECTION
120.99	COST FOR ONE HORIZ. EXT. SECTION (PIPE, 2 FLANGES, 4 COUPLINGS, 2 ELBOWS, 1 END CAP)
3	HORIZ. EXT. SECTIONS
$362.97	TOTAL COST = HORIZ. EXT. SECTIONS X CELLS INSTALLED

	$497.13	CAPITAL

EXTRACTION MANIFOLD

TIES TOGETHER ALL VAPOR EXTRACTION COMPONENTS FOR TWO CELLS
COMPONENTS FOR 2 CELLS INCL. 3 ROWS GROUND ELECTRODES AND 3 HORIZ. EXTRACTION SECTIONS
MANIFOLD CONSTR. WITH FLANGE DIVIDING EACH CELL AND VALVE BETWEEN EACH COMPONENT
FLEXIBLE VACUUM HOSE TIES MANIFOLD TO INDIV. EXTRACTION COMPONENTS

15.50	COST FOR 2" FLANGE 15.50 (VEE)
0.26	COST PER LF FOR 2" GREEN THREAD FIBERGLASS PIPE
34.15	COST FOR 2" FIBERGLASS TEE (VEE)
5.00	COST FOR THREADED FIBERGLASS ADAPTER (VEE)
9.15	COST FOR 2" HOSE COUPLING (1 MALE/1 FEMALE) (VEE)
2.94	COST PER LF OF VACUUM HOSE (VEE)
19.90	COST FOR 2" BRONZE BALL VALVE (ESCO)
23.65	COST FOR 2" 90 DEG. ELBOW
106	LENGTH OF PIPE = 3 X CELL LENGTH + 10' FOR MISC. SECTIONS
6	VALVES REQUIRED = 3 ELECTRODE ROWS + 3 HORIZ, EXT. SECTIONS
6	NUMBER OF 3' HOSE SECTIONS WITH 2 COUPLING SETS REQUIRED
$497.13	TOTAL COST = PIPE, 2 FLANGES, 3 ELBOWS, 6 TEES, 6-3' HOSE SECTIONS WITH COUPLINGS

VAPOR EXTRACTION/TREATMENT

	$1,699.80	CAPITA

REGENERATIVE BLOWER

HOUSED ON 40' FLATBED TRAILER WITH CAT/OX UNIT

1053.00	REGENERATIVE BLOWER COST - GAST MODEL R6350A-2
56.80	VACUUM GAUGE
109.80	MUFFLER
307.50	FILTER
172.70	RELIEF VALVE
$1,699.80	TOTAL COST FOR BLOWER AND ACCESSORIES

	$250,000.00	CAPIT.

CATALYTIC OXIDATION TREATMENT UNIT WITH NaOH PRECIPITATION

HOUSED ON A 40' FLAT BED TRAILER. UNIT INCLUDES AMBIENT AIR CONDENSER, WATER SEPARATOR, CATALYTIC OXIDIZER, AND NaOH PRECIPITATION UNIT.

$250,000.00	TOTAL COST FOR TRAILER-MOUNTED TREATMENT UNIT

LABOR

LAB

GENERAL

SITE PREPERATION AND DEMOB

	SALARY	HR RATE	
PROJECT MANAGER (ENGR)	60,000	28.85	
SR RF ENGINEER	55,000	26.44	
JR RF ENGINEER	45,000	21.63	
SR FIELD TECHNICIAN	35,000	16.83	
		93.75	
		117.19	OVERHEAD (125%)
		21.09	G&A (10%)
		232.03	CREW HOUR

OPERATION

	SALARY	HR RATE	
PROJECT MANAGER (ENGR)	60,000	28.85	
SR RF ENGINEER	55,000	26.44	
JR RF ENGINEER	45,000	21.63	
JR RF ENGINEER	45,000	21.63	
SR FIELD TECHNICIAN	35,000	16.83	
SR FIELD TECHNICIAN	35,000	16.83	
		132.21	
		165.26	OVERHEAD (125%)
		29.75	G&A (10%)
		327.22	CREW HOUR

SITE PREPARATION/SET-UP

INCLUDES FENCING, MATERIAL RECEIPT, TRAILER/SITE SETUP, ELECTRICAL, DOGHOUSE FAB., MISC. ACTIVITIES — **$55,687.50** — LABOR
4-MAN CREW WORKING 8 HR DAYS, 5 DAYS PER WEEK

6	TIME REQUIRED IN WEEKS
232.03	LABOR RATE FOR 4 MAN CREW (INCLUDES ALL INDIRECTS)
40	CREW HOURS PER WEEK
240	TOTAL CREW HOURS REQUIRED FOR SITE PREPARATION/SET-UP
$55,687.50	TOTAL COST FOR SITE PREPARATION/SET-UP

TREATMENT

INCLUDES RF/SVE OPERATION, PROJECT MANAGEMENT, AND REPORTING — **$403,139.42** — LABOR
DOES NOT INCLUDE INITIAL 4 WEEK SET-UP OR FINAL DEMOBILIZATION
2 MEN ON SITE 24 HOURS PER DAY 7 DAYS PER WEEK (=56 CREW HRS)

0.1	CONTINGENCY FACTOR FOR LOST TIME
327.22	LABOR RATE FOR 4 MAN CREW (INCLUDES ALL INDIRECTS)
56	CREW HOURS PER WEEK
20	TOTAL WEEKS OF TREATMENT
1120	TOTAL CREW HOURS REQUIRED FOR TREATMENT
$403,139.42	TOTAL COST FOR TREATMENT CREW

SITE RESTORATION/DEMOBILIZATION — **$18,562.50** — LABOR

2	TIME REQUIRED IN WEEKS
232.03	LABOR RATE FOR 4 MAN CREW (INCLUDES ALL INDIRECTS)
40	CREW HOURS PER WEEK
80	TOTAL CREW HOURS REQUIRED FOR SITE RESTORATION/DEMOBILIZATION
$18,562.50	TOTAL COST FOR SITE RESTORATION/DEMOBILIZATION

SITE SUPPORT

TRUCKS AND TRAILERS

ONE TON UTILITY TRUCK WITH OVERHEAD WINCH, HYDRAULIC LIFT, AND SMALL TRAILER — **$35,000** — CAPITAL

CELLULAR TELEPHONE — **$4,875.00** — SERVICES

750.00	MONTHLY RENTAL RATE
7	MONTHS NEEDED
$4,875.00	TOTAL RENTAL COST FOR CELLULAR TELEPHONE

$47,559.72 DISPOSABLES

MISCELLANEOUS ODCS

		UNIT	UNIT COST	EST. QTY
21.10	ALUMINUM FOIL	ROLL	2.11	10
39.84	BARRIER TAPE	ROLL	9.96	4
116.10	BOOT COVERS	PAIR	11.61	10
455.00	CHEMICAL TOILET	MONTH	65.00	7
204.00	COTTON GLOVES	PAIR	0.68	300
6.00	DECON TUB	EACH	3.00	2
375.00	16-GAL EYEWASH	EACH	375.00	1
205.00	DRAEGER PUMP	EACH	205.00	1
132.00	DRAEGER TUBES	EACH	33.00	4
5145.00	FRAC TANK RENTAL	DAY	35.00	147
546.20	FULL FACE RESP.	EACH	136.55	4
53.00	HARD HATS	EACH	5.30	10
4929.80	HNU DETECTOR	EACH	4,929.80	1
78.85	HPLC (4L)	4L	15.77	5
1253.00	LEL/O2 METER W/ ACC.	EACH	1,253.00	1
146.32	LIQUINOX DETERGENT	GAL	18.29	8
86.34	METHANOL (4L)	4L	28.78	3
2000.00	MILEAGE (TRUCK)	MILE	0.50	4000
84.60	MSA COMB. CARTRIDGES	EACH	2.82	30
600.00	NaOH	LB	0.15	4000
113.00	NITRILE GLOVES	PAIR	1.13	100
5046.00	OVA	EACH	5,046.00	1
28.10	PACKING TAPE	ROLL	2.81	10
74.00	PAPER TOWELS	ROLL	0.74	100
23284.80	PROPANE (CAT/OX)	GAL	0.63	36960
10.08	PIN FLAGS (BDL50)	BDL	2.52	4
209.60	SAFETY GLASSES	EACH	5.24	40
21.60	SAMPLE BOWL/TROWEL	EACH	7.20	3
74.20	SPAN GAS (HNU)	TANK	37.10	2
72.08	SPAN GAS (LEL/O2)	TANK	36.04	2
1850.00	STEAM CLEANER	EACH	1,850.00	1
43.45	SURGEONS GLOVES	BOX	8.69	5
127.00	TRASH BAGS	BOX	6.35	20
104.76	TYVEK COVERALLS	EACH	2.91	36
23.90	ZIPLOCK BAGS	BOX	2.39	10

$47,559.72 TOTAL MISCELLANEOUS ODC COST

$9,200.00 CAPITAL

FENCING

FENCE DIMENSIONS ARE 300' BY 200', INSTALLED WITH TWO GATES

11.50	COST PER LINEAR FOOT FOR FENCING, INCLUDES GATES
800	TOTAL LINEAR FOOTAGE REQUIRED
$9,200.00	TOTAL COST

$2,500.00 DISPOSABL

GRAVEL

USED TO REGRADE SITE DURING RESTORATION

$2,500.00 TOTAL COST FOR GRAVEL (EST)

$1,400.00 DISPOSABI

CONCRETE

TRANSFORMER PAD

$1,400.00 8' X 8' CONCRETE PAD WITH FENCING (EST.)

$1,700.00 DISPOSAB

LIGHTS

PERIMETER LIGHTS FOR SITE SECURITY AND NIGHT OPERATIONS

85.00	EST. COST PER LIGHT INCLUDING POST AND ELECTRICAL HOOKUP
20	NUMBER OF LIGHTS REQUIRED
$1,700.00	TOTAL COST FOR LIGHTING

WASTE DISPOSAL **$7,107.50** SERVICES

SLUDGE FROM NaOH PRECIPITATION UNIT, LIQUID FROM AMBIENT AIR CONDENSER, EXCESS SOIL, AND MISCELLANEOUS (PPE, USED HOSE, ETC.)

2.50	COST PER MILE FOR HAZWASTE TRANSPORT (EST)
25.00	COST FOR BULK DRUM TRANSPORT (EST)
0.40	COST FOR INCINERATION PER POUND (EST)
150.00	COST PER DRUM FOR HANDLING DURING INCINERATION PER POUND (EST)
350.00	COST PER DRUMFOR LANDFILL (EST)
300.00	COST PER DRUM FOR LANDFILL PICK-UP & HANDLING (EST)
0.25	COST PER GALLON FOR WATER TREATMENT (EST)
6,000	NaOH SLUDGE (LB) - (10 DRUMS)
$4,150	COST TO DRUM, TRANSPORT, & INCINERATE
5,000	LIQUID (GAL)
630	DECON WATER (GAL)
$1,533	COST TO TRANSPORT (50 MILES) & TREAT
3	MISC. (DRUMS)
$1,425	COST TO TRANSPORT & LANDFILL

SUBCONTRACTOR SUPPORT

DRILLING AND ABANDONMENT **$24,664.20** SERVICES

SYSTEM INSTALL

1.00	COST FOR 100 LB. BAG SAND BACKFILL (1 CUBIC FOOT)
10.50	COST FOR 50 LB BAG BENTONITE CHIPS (0.79 CUBIC FEET)
13.00	COST PER FOOT FOR BORING (4.25" HS AUGER)
15.00	COST PER FOOT FOR BORING (8" HS AUGER)
100.00	COST PER HOUR FOR STANDBY, SITE RESTORATION, MISC. CREW TIME
30.00	COST PER HOUR FOR DECON
250.00	MOB/DEMOB RATE EACH MOBILIZATION
30.00	COST PER BORING FOR SAMPLING
12	GROUND ELECTRODES PER ROW
3	GROUND ELECTRODE ROWS IN TREATMENT AREA
30	DEPTH OF GROUND ELECTRODE BOREHOLES
1080	TOTAL LINEAR FOOTAGE OF GROUND ELECTRODE BOREHOLES
8	EXCITOR ELECTRODES PER ROW
2	EXCITOR ELECTRODE ROWS IN TREATMENT AREA
22	DEPTH OF EXCITOR ELECTRODE BOREHOLES (8' HS AUGER)
352	TOTAL LF OF EXCITOR ELECTRODE BOREHOLES (8' HS AUGER)
6	THERMAL MEASUREMENT WELLS
180	TOTAL LF OF THERMAL MEASUREMENT WELLS (4.25' AUGER)
8	PRESUURE MEASUREMENT WELLS
127	TOTAL LF OF PRESSURE MEASUREMENT WELLS (4.25" AUGER)
1432	LF OF GROUND/EXCITOR ELECTRODE BORING
$18,616.00	DRILLING COST AT $15 PER FOOT
307	LF OF PRESSURE/THERMAL MEASUREMENT WELLS
$3,991.00	DRILLING COST AT $13 PER FOOT
12	NUMBER OF BORING REQUIRING SAMPLING
$360.00	COST FOR SAMPLING ($30 EACH)
12	REQUIRED AUGER DECONS (BEFORE EACH SAMPLE AND AT END)
1	TIME FOR EACH DECON (HRS)
$360	COST FOR DECON
501	100 LB. BAGS OF SAND REQUIRED (7 BAGS PER 20' OF BORING)
$501.20	TOTAL SAND COST
52	50 LB. BAGS OF BENTONITE REQUIRED (2 BAGS PER BOREHOLE) FOR INSTALLATION
$546.00	TOTAL BENTONITE COST

1	MOBILIZATIONS FOR ENTIRE TREATMENT AREA		
250.00	COST PER MOBILIZATION/DEMOBILIZATION		
$250.00	TOTAL MOBILIZATION COST		
4	STANDBY HRS (EST)		
$400.00	COST PER HR FOR STANDBY	$23,390.00	SERVICES

SYSTEM ABANDONMENT (DISMANTLE)

100.00	COST PER HR FOR RIG TIME		
10.50	COST OF 50 LB BAG BENTONITE CHIPS (0.79 CUBIC FEET)		
30.00	COST PER HOUR FOR DECON		
250.00	MOB/DEMOB RATE		
30.00	COST PER BORING FOR SAMPLING		
2.00	TIME IN HOURS TO ABANDONE AN EXCITOR ELECTRODE (PULL & BENTONITE FILL)		
2.50	TIME IN HOURS TO ABANDONE A GROUND ELECTRODE (PULL & BENTONITE FILL)		
2.50	TIME IN HOURS TO ABANDONE A PMW OR TMW (PULL & BENTONITE FILL)		
15.00	COST FOR EACH ABANDONMENT REPORT		
5.00	CUBIC FT BENTONITE PER HOLE (EST)		
10	NUMBER OF BORING REQUIRING SAMPLING		
$300.00	COST FOR SAMPLING ($30 EACH)		
10	NUMBER OF SOIL SAMPLE HOLES		
12	AVERAGE DETPH IN FT OF BOREHOLE (8" DIA)		
$1,800.00	COST OF DRILLING		
16	NUMBER OF EXCITOR ELECTRODES		
$3,440	COST TO ABANDONE		
36	NUMBER OF GROUND ELECTRODES		
$9,540	COST TO ABANDONE		
14	NUMBER OF PMW's AND TMW's EXCITOR ELECTRODES		
$3,710	COST TO ABANDONE		
76	NUMBER OF HOLES		
$3,990	BENTONITE COST		
12	REQUIRED AUGER DECONS (BEFORE EACH SAMPLE AND AT END)		
1	TIME FOR EACH DECON (HRS)		
$360	COST FOR DECON		
1	MOBILIZATIONS FOR ENTIRE TREATMENT AREA		
250.00	COST PER MOBILIZATION/DEMOBILIZATION		
$250.00	TOTAL MOBILIZATION COST	$42,900.00	SERVICES

ANALYTICAL

SOIL

850.00	ANALYTICAL COST PER SAMPLE FOR VOCs, SVOCs, TPH, MOISTURE, AND SIEVE
22	NUMBER OF SAMPLES TO BE ANALYZED (20 SOIL & 2 WATER)
100.00	SAMPLE SHIPPING COST PER EVENT
200.00	TOTAL SHIPPING COST
$18,900.00	TOTAL ANALYTICAL COST

VAPOR STREAM

4000.00	ANALYTICAL COST PER SAMPLE FOR VOCs, SVOCs, TPH, MOISTURE, AND SIEVE
6	NUMBER OF SAMPLES TO BE ANALYZED (20 SOIL & 2 WATER)
$24,000.00	TOTAL ANALYTICAL COST

TABLE 3
IITRI AMORTIZATION COST DETAILS
RF SOIL DECONTAMINATION DEMONSTRATION

CAPITAL EQUIPMENT ITEM	EQUIPMENT COST	SALVAGE VALUE	ANNUAL CAPITAL COST	ANNUAL MAINTANENCE COST		ANNUAL COST
RF TRANSMITTER	$242,000	$48,400.00	$51,071	10%	$24,200	$75,271
RF CONTROL UNIT	$600,000	$120,000.00	$126,623	10%	$60,000	$186,623
COAXIAL TRANSMISSION LINE	$11,280	$564.00	$2,827	25%	$2,820	$5,647
EXCITOR ELECTRODES	$2,300	$115.00	$576	25%	$575	$1,151
GROUND ELECTRODES	$11,664	$583.20	$2,923	25%	$2,916	$5,839
RF SHIELD	$6,664	$333.19	$1,670	25%	$1,666	$3,336
VACUUM/PRESSURE GAUGES	$138	$0.00	$36	25%	$35	$71
GROUND ELECTRODE PIPING	$1,188	$0.00	$314	50%	$594	$908
HORIZONTAL EXTRACTION PIPING	$363	$0.00	$96	50%	$181	$277
EXTRACTION MANIFOLD	$497	$0.00	$131	50%	$249	$380
BLOWER	$1,700	$339.96	$359	10%	$170	$529
CATOX TREATMENT UNIT	$250,000	$50,000.00	$52,759	10%	$25,000	$77,759
TRUCKS AND TRAILERS	$35,000	$7,000.00	$7,386	10%	$3,500	$10,886
FENCING	$9,200	$0.00	$2,427	50%	$4,600	$7,027
TOTAL	**$1,171,994**	**$227,335**	**$249,199**		**$42,306**	**$375,704**